This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

354309

FOURTH
ANNUAL
CONVENTION

AMERICAN SOCIETY
—OF—
MUNICIPAL IMPROVEMENTS.

HELD AT
NASHVILLE, TENN.

OCTOBER
5TH, 6TH, 7TH AND 8TH.
1897.

Proceedings of the

Fourth Annual Convention

of the

American Society

of

Municipal Improvements

Held at

Nashville, Tennessee.

October, 5th, 6th, 7th and 8th,

1897.

THE NEW YORK
PUBLIC LIBRARY
354309
ASTOR, LENOX AND
TILDEN FOUNDATIONS
R [illegible] L

SWAIN & TATE CO., MILWAUKEE.

American Society of Municipal Improvements.

......OFFICERS.....

1897-1898.

President	HARRISON VAN DUYNE	Newark, N. J.
First Vice President	L. W. RUNDLETT	St. Paul, Minn.
Second Vice President	E. H. KEATING	Toronto, Can
Third Vice President	A. D. THOMPSON	Peoria, Ill.
Secretary	D. L. FULTON	Allegheny, Pa.
Treasurer	J. L. KENNEDY	Nashville, Tenn.

FINANCE COMMITTEE.

F. J. O'BRIEN	Oswego, N. Y.
H. J. STANLEY	Cincinnati, O.
E. W. BOYNTON	Davenport, Ia.

EXECUTIVE COMMITTEE.

The officers of the Society, together with the Past Presidents, constitute the Executive Committee.

The Past Presidents are as follows:

M J. MURPHY	St. Louis, Mo.
GEO. H. BENZENBERG	Milwaukee, Wis.
AUG. HERRMANN	Cincinnati, O.

Standing Committees American Society Municipal Improvements.

Appointed by President in accordance with Article IV, Section 4, of the Constitution of the Society.

1897-1898.

STREET PAVING.

NELSON P. LEWIS, Brooklyn, N. Y.
EDWARD B. GUTHRIE, Buffalo, N. Y.
GEO. N. AMES, Grand Rapids, Mich.

ELECTRIC STREET LIGHTING.

F. W. CAPPELLEN, Minneapolis, Minn.
DAVID HUNTER, Jr., Allegheny, Pa.
ROBERT BALLARD, Syracuse, N. Y.

SEWERAGE AND SANITATION.

Capt. LANSING H. BEACH, Washington, D. C.
Dr. J. M. WITHROW, Cincinnati, O.
J. H. PEARSON, Louisville, Ky.

WATER WORKS AND WATER SUPPLY.

M. L. HOLMAN, St. Louis, Mo.
M. R. SHERRERD, Newark, N. J.
WILLIS P. THARP, Cincinnati, O.

TAXATION AND ASSESSMENT.

AUGUST HERRMANN, Cincinnati, O.
R. E. HORNER, Parkersburg, West Va.
GEO. E. MOSHER, Chillicothe, O.

CITY GOVERNMENT AND LEGISLATION.

L. E. FARNHAM, Camden, N. J.
CHAS. O. BRIGHTMAN, New Bedford, Mass
THOS. McMILLAN, Rochester, N. Y.

DISPOSITION OF GARBAGE AND STREET CLEANING.

Dr. J. L. HESS, Cleveland, O.
Dr. ARTHUR R. REYNOLDS, Chicago, Ill.
O. E. DAVIDSON, Dayton, O.

MUNICIPAL FRANCHISES.

ANDREW ROSEWATER, Omaha, Neb.
BERNARD SAUNDERS, Toronto, Canada
PHILLIP C. JUSTUS, St. Paul, Minn.

REVIEW.

GEO. H. BENZENBERG, Milwaukee, Wis.
THOS. H. KENNEDY, Covington, Ky.
M. A. DOWNING, Indianapolis, Ind.

Special Committees.

Appointed by President in accordance with resolutions adopted by Society.

MUNICIPAL DATA.

CHARLES CARROL BROWN, Bloomington, Ill.
Capt. LANSING H. BEACH, Washington, D. C.
A. D. THOMPSON, Peoria, Ill.

COATING OF CAST IRON & STEEL RIVETED PIPES.

L. W. RUNDLETT, St. Paul, Minn.
E. E. BARROW, Hamilton, Ont.
F. M. LILLIE, Youngstown, O.

ELECTROLYSIS.

HAROLD P. BROWN, New York, N. Y.
J. A. CABOT, Cincinnati, O.
E. W. BOYNTON, Davenport, Ia.

AMERICAN SOCIETY

OF

MUNICIPAL IMPROVEMENTS.

CONSTITUTION OF THE SOCIETY.

ARTICLE I.—NAME AND OBJECT.

Sec. 1. The objects of this society, which shall be known as "The American Society of Municipal Improvements," shall be to disseminate information and experience upon, and to promote the best methods to be employed in, the management of municipal departments and in the construction of municipal works, by means of annual conventions, the reading and discussion of papers upon municipal improvements, and by social and friendly intercourse at such conventions, and to circulate among its members, by means of an annual publication, the information thus obtained.

ARTICLE II.—MEMBERSHIP.

Sec. 1. Any municipality within America shall be eligible to membership in this society; likewise any engineer, officer, or director who shall have charge of or supervision over, or be employed as a consulting engineer on any public or municipal department work. When a municipality has become a member of the society, then any person of such municipality representing any municipal board or department may also become a member.

Sec. 2. Every application for membership shall be in writing, stating the name, location, and department; and, if of an individual, shall also state the age, residence, and position of the applicant.

Sec. 3. Any member who shall have ceased to have charge or supervision of any public or municipal department or work may become an associate member, who shall enjoy all the rights and privileges of full membership, excepting that of holding office or voting.

Sec. 4. Any member who shall be in arrears for more than one year's dues shall be considered as no longer a member of this society, and his or its name shall be discontinued from the roll by the Secretary.

Sec. 5. Any member may withdraw from the society upon payment of all dues to date, and by notifying the Secretary thereof in writing.

Sec. 6. Any member may be expelled from the society upon the recommendation of the Executive Committee, adopted by a two-third vote of all the members present.

ARTICLE III.—Fees and Dues.

Sec. 1. Each municipality desiring to become a member of this society may do so by the payment of five dollars admission fee, which will entitle said municipality to as many members to said society representing boards or departments of said municipality as may be desired without any additional admission fee, but upon payment of the dues hereinafter prescribed.

Sec. 2. Municipalities shall not be required to pay any dues; but each individual representing any department of a municipality that has acquired a membership in the society, or any associate member, shall pay three dollars per annum as dues, the same to be payable on or before the date of the annual meeting.

ARTICLE IV.—Officers.

Sec. 1. The officers of this society shall consist of a President, three Vice-Presidents, a Secretary, and a Treasurer, each of whom shall be a resident of a different State, and who with the Past Presidents shall act as an Executive Committee for and in behalf of the society.

Sec. 2. There shall also be elected a Finance Committee, consisting of three members of the society.

Sec. 3. In case of any of the above positions, excepting the presidency, becoming vacant, or in case of their absence during the annual convention, the President shall fill such vacancy by appointment from the membership.

Sec. 4. There shall be appointed annually the following standing committees:

1. Street-Paving;
2. Electric Street-Lighting;
3. Sewerage and Sanitation;
4. Waterworks and Water-Supply;
5. Taxation and Assessments;
6. City Government and Legislation;
7. Disposition of Garbage and Street Cleaning;
8. Review;
9. Municipal Franchises.

The number on each committee shall be three, and the Chairman may add such names as he may deem advisable. No special or standing committee shall be authorized to create any liabilities unless the same shall have been first approved by the Executive Committee.

ARTICLE V.—ELECTION.

Sec. 1. The officers of this society shall be elected by ballot on the second day of each annual convention, and each municipality shall be entitled to as many votes as it has representatives present.

Sec. 2. The President shall not be eligible for immediate reëlection (except by a unanimouse vote).

Sec. 3. The officers elected shall assume office immediately after the close of the annual meeting at which they were elected.

Sec. 4. The ballot for any officer may be waived by unanimous consent.

ARTICLE VI.—DUTIES.

Sec. 1. The President shall preside at the meetings of the society and at those of the Executive Committee, and shall perform such other duties as are incumbent upon the office. In the absence of the President, or upon his becoming ineligible, the senior Vice-President shall assume and perform the duties of the office.

Sec. 2. The Secretary shall keep accurate minutes of the proceedings of the society and of the Executive Committee; shall conduct all correspondence; shall issue notices of any meeting of the society not less than four weeks prior to the date of such meeting; shall collect and receipt for all fees and dues. and pay them to the Treasurer quarterly, taking his receipt for the same; and keep accurate account between the society and its members.

Sec. 3. The Treasurer shall receive from the Secretary and safely keep all moneys belonging to the society, giving his receipt therefor; shall pay all bills approved by the Finance Committee or the President; shall keep a correct account of the funds of the society, and submit to it at its annual meeting a report of all receipts and disbursements during the preceding year.

Sec. 4. The Executive Committee shall manage all the affairs of the society, subject to the action and approval of the society at its meeting. All questions in Executive Committee shall be decided by a majority vote, and five members shall constitute a quorum, not less than four of whom shall be officers of the society. The Executive Committee shall meet at least once each year, on the morning of the first day of the annual meeting of the society, and as much oftener as the President may determine.

Sec. 5. The Finance Committee shall meet on the morning of the first day, and previous to the annual meeting of the society. to examine and audit the Secretary's and Treasurer's accounts and annual statements, and report thereon to the society.

Sec. 6. It shall be the duty of the Chairman of each standing committee to prepare a report, with the aid of his fellow-committeemen, and submit the same at the annual meeting.

Sec. 7. One afternoon and such other time as may be deemed necessary shall be devoted to sectional work, the Chairman of each standing committee acting as Chairman of the section. The Chairman of each section shall arrange the programme of the sectional meetings in connection with the Programme Committee of the society.

ARTICLE VII.—MEETINGS.

Sec. 1. The annual meeting of this society shall be held on the second Wednesday in October of each year, in such city as the majority of the members voting shall decide. Selection of place of meeting to be made after the officers shall have been elected.

Sec. 2. At any annual meeting of the society fifty members shall constitute a quorum for the transaction of business.

Sec. 3. Any member with the concurrence of the presiding officer may admit friends to the meeting of the society, but such person or persons shall not without the consent of the meeting be permitted to take part in any discussion.

Sec. 4. All papers, drawings, etc., submitted to the meeting of the society shall be and remain the property of the society.

ARTICLE VIII.—ORDER OF BUSINESS.

Sec. 1. At the annual meeting of the society the order of business shall be as follows:

1. Roll call;
2. Reading of minutes of last meeting;
3. Considering of applications for membership;
4. The President's address;
5. Reports of the Secretary and the Treasurer;
6. Report of the Executive Committee;
7. Report of the Finance Committee;
8. Reports of special committees;
9. Reading and discussion of papers;
10. Election of officers;
11. Selecting next place of meeting;
12. General business.

Sec. 2. All questions shall be decided by vote, and all differences of opinion in regard to points of order shall be settled by parliamentary practice, as set forth in Cushing's Manual.

ARTICLE IX.—AMENDMENTS.

Sec. 1. The foregoing constitution and articles may be amended on or after the second day of any annual meeting of the society by a two-third vote of all members voting; provided such proposed amendment shall have been submitted to the society in writing on the first day of its annual meeting.

Membership American Society Municipal Improvements.

1897-1898.

Atchison, Kan	Fred. Giddings	City Engineer.
Allegheny, Pa	W. G. Wilkins	" "
"	D. L. Fulton	Supt. of Highways.
"	G. C. Langenheim	City Engineer.
"	J. L. Brown	Supt. Bureau Water.
"	David Hunter, Jr	Supt. Bureau Light.
Akron, O	S. W. Parshall	City Engineer.
Bloomington, Ill	W. P. Butler	" "
Binghamton, N. Y.	S. E. Monroe	" "
Buffalo, N. Y	Edward B. Guthrie	Chief Engineer.
"	John H. Shifferens	Superintendent Streets.
"	M. M. Drake	Board of Public Works.
Brooklyn, N. Y	N. P. Lewis	Eng. Street Construction.
"	Geo. W. Tillson	City Engineer.
Bridgeport, Conn	F. W. Beers	Pres. Board Public Works.
Burlington, Ia	William Steyh	City Engineer.
Calgary, Can	Chas. McMillan, Esq	City Clerk.
Camden, N. J	W. H. Tice	Dept. Streets.
"	H. J. Sharp	" "
"	E. S. Mills	" "
"	L. E. Farnham	City Engineer.
"	Chas. P. Sayrs	Chairman Public Works.
"	John Blowe	Street Commissioner.
Concord, N. H	W. B. Howe	City Engineer.
Champagne, Ill	Arthur N. Talbot	Consulting Engineer.
Chillicothe, O	C. C. Waddle	Mayor.
"	H. M. Redd	City Engineer.
"	W. W. Fair	Dept. Public Works.
"	Geo. E. Mosher	" " "
"	Chas. H. Rentinger	" " "
"	George L. Emmel	" " "
"	S. Earl Mosher	Ex-Councilman.
Cincinnati, O	August Herrmann	Pres. Board Administr.
"	John Frey	Board Administration.
"	John B. Washburn	" "
"	Geo. T. Sterritt	" "

Cincinnati, O.	Dr. J. M. Witherow	Health Officer.
"	George A. Vandegrift	Board Administration.
"	Edward Bogen	Superintendent Infirmary.
"	A. P. Butterfield	Clerk Board Administr.
"	H. J. Stanley	Chief Engineer.
"	Willis P. Tharp	Supt. & Eng. Water Wks.
"	Fred. Amthauer	Supt. Street Cleaning.
"	John A. Cabot	City Electrician.
"	R. H. Warder	Superintendent Parks.
"	Albert Cox	Purchasing Agent.
Chicago, Ill.	L. B. Jackson	City Engineer.
"	H. D. Patton	City Sealer.
"	W. D. Kent	Commsnr. Public Works.
"	G. L. Clausen	Supt. Bureau Sewers.
"	Dr. Arthur R. Reynolds	Health Commissioner.
"	Frank B. Rae, C. E.	Consulting Engineer.
Covington, Ky	J. L. Rhinock	Mayor.
"	D. Seger	Water Works Commsnr.
"	W. H. Glore	Supt. Water Works.
"	Thos. H. Kennedy	City Engineer.
Cleveland, O.	J. L. Hess, M. D.	Health Officer.
"	D. E. Wright	Director Public Works.
Concord, N. H.	W. B. Howe	City Engineer.
Dayton, O	C. A. Herbig	City Comptroller.
"	Wm. F. Miller	Asst. City Comptroller.
"	Peter Weidner	Pres. Board City Affairs.
"	O. E. Davidson	" " "
"	T. J. Backus	Superintendent Streets.
"	F. M. Turner	City Engineer.
"	Chas. E. Rowe	Secretary Water Works.
"	B. B. Childs	Trustee Water Works.
"	R. T. McGregor	" "
Davenport, Iowa	E. W. Boynton	Com. Public Works.
Dubuque, Iowa	W. H. Knowlton	Chief Engineer.
"	Henry B. Gniffke	City Treasurer.
"	John E. Stemm	City Assessor.
Dupont, Ga	Augustus Dupont	
Eau Claire, Wis	C. A. Alderman	City Engineer.
Fort Wayne, Ind	Peter Eggemann	Board Public Works.
"	A. M. Schmidt	" " "
"	P. H. Kane	" " "
"	Chas. Herwig	" " "
"	B. Barkenstein	Councilman.

Grand Rapids, Mich.	F. Letellier	Board Public Works.
"	J. J. McVean	" " "
"	L. C. Stowe	" " "
"	Geo. M. Ames	City Engineer.
"	F. A. Twamley	City Clerk.
"	C. G. Swensberg	Pres. Board Public Works.
Hamilton, Can.	E. G. Barrows, C. E.	City Engineer.
Hamilton, O.	L. A. Dillon	City Engineer.
Harrisburg, Pa.	John McConkey	Highway Commissioner.
Indianapolis, Ind.	M. A. Downing	Ch'n Board Public Works.
"	B. J. T. Jeup	City Engineer.
Kalamazoo, Mich.	J. R. McCall	Street Commissioner.
Lafayette, Ind.	W. K. Eldridge	City Engineer.
Los Angeles, Cal.	C. S. Compton	" "
Lima, O.	R. H. Gamble	" "
Louisville, Ky.	J. H. Pearson	" "
Mansfield, O.	D. S. Koontz	President of Council.
Milwaukee, Wis.	Geo. H. Benzenberg	City Eng. & Pres. Board Public Works.
"	S. J. Brockman	Department Public Works.
"	Fred. Schneider	" " "
"	Paul Muenzberg	" " "
Marietta, O.	Jacob Rech	Councilman.
"	Phil. Bachman	"
"	B. F. Wood	"
"	E. A. Cochlan	"
"	S. J. Hathaway	President Council.
Minneapolis, Minn.	F. W. Cappelen	City Engineer.
Newark, N. J.	Wm Stainsby	Pres. Board Public Works.
"	Harrison Van Duyne	Board Public Works.
"	Chas. F. Herr	" " "
"	Wm. S. Greathead	Clk. Board Public Works.
"	Peter Ulrich	Board Public Works.
"	John Burkhardt	" " "
"	M. R. Sherrerd	Engineer Water Dept.
"	Ernest Adam	City Engineer.
Nashville, Tenn.	John L. Kennedy	Board Public Works.
New Bedford, Mass.	A. L. Blackmer	" " "
"	Geo. P. Bailey	" " "
"	S. C. Hathaway	" " "
"	Chas. O. Brightman	" " "
"	Wm. S. Cook	Clk. Board Public Works.
New Haven, Conn.	L. H. Johnson	Pres. Board Public Works.

Newport, Ky.	John Surran	Supt. Water Works.
“	W. L. Glazier	City Engineer.
“	Jas. Knoblock	Supt. Public Works.
New York, N. Y.	Harold C. Brown	Consulting Engineer.
Nashua, N. H.	Fred. F. Stark	Pres. Pennichuk Wr. Wks.
Omaha, Neb.	Charles Carroll Brown	Consulting Engineer.
“	Andrew Rosewater	City Engineer and Pres. Board Public Works.
“	Frank J. Kaspar	Member Public Works.
Oswego, N. Y.	F. J. O'Brien	Supt. Public Works.
Ottawa, Can.	Hon. Samuel Bingham	Mayor.
Parkersburg, W. Va.	R. H. Thomas	Mayor.
“	R. E. Horner	Pres. Board of Trade.
“	W. W. Van Winkle	Member Board of Trade.
“	W. N. Chancellor	“ “ “
“	H. H. Moss	“ “ “
“	C. C. Martin	Member Board Trade.
Peoria, Ill.	Will O. Clark	Commisns. Public Works.
“	Jacob A. Harman	Consulting Engineer.
“	A. D. Thompson	City Engineer.
Pittsburg, Pa.	S. A. Taylor, C. E.	Consulting Engineer.
Plainfield, N. J.	Geo. H. Frost	Chr. Sewer Committee.
Portland, Me.	Geo. N. Fernald	City Engineer.
Quebec, Can.	Hon. Jere Gallagher	Mayor.
Quincy, Ill.	D. F. Dederick	
Richmond, Conn.	Joseph J. Ratliff	Sec. Park Com.
Rochester, N. Y.	Edwin A. Fisher	City Engineer.
“	Thos. McMillan	Board Public Works.
Saginaw, Mich.	R. W. Roberts	Ex-City Engineer.
South Bend, Ind.	W. M. Whitten	City Engineer.
St. Louis, Mo.	Robert E. McMath	Pres. Public Improvements
“	M. L. Holman	Water Commissioner.
“	B. H. Colby	Sewer Commissioner.
“	Frank L. Ridgeley	Park Commissioner.
“	C. H. Stone	Harbor & Wharf. Com's.
“	Julius Wurzburger	Asst. Street Commr.
Syracuse, N. Y.	R. R. Stuart	City Engineer.
“	Robert Ballard	Member Board Aldermen.
“	Frank V. Matty	Pres. Board of Aldermen.
“	Duncan W. Peck	
“	Henry L. Allen	Ex-City Engineer.

St. Paul, Minn.	L. W. Rundlett	City Engineer.
"	John Copeland	Pres. Board Public Works.
"	Philip Justus	Mem. Board Public Works.
Sheboygan, Wis.	C. N. Boley	City Engineer.
Toledo, O.	C. S. Brown	Water Works Trustee.
Toronto, Canada	E. H. Keating	City Engineer.
"	John Jones	Street Sommissioner.
"	Bernard Saunders	Chr. Board of Works.
"	John K. Leslie	Chr. Exhibition Com.
Williamsport, Pa.	Geo. D. Snyder	City Engineer.
Wilmington, Del.	Harvey J. Wiley	Sec. Street and Water Dept
Washington, D. C.	Lansing H. Beach	Captain Engineers.
"	Wm. C. Woodward, M. D	Health Officer.
Washington, C. H., O	H. B. Brownell	Councilman.
Youngstown, O.	F. M. Lillie	City Engineer.
"	Rudolph Kurz	Councilman.
"	Veeder Heasley	Pres. Board City Comrs.
"	John DeVenne	President Councils.
"	Wm. Cornelius	
"	M. S. Clark, M. D.	
Zanesville, O.	I. P. Farquhar, M. D.	Councilman.

AMERICAN SOCIETY

OF

MUNICIPAL IMPROVEMENTS.

FOURTH ANNUAL CONVENTION,

NASHVILLE, TENNESSEE, OCTOBER 5, 6, 7 AND 8, 1897.

TUESDAY, OCTOBER 5, 1897.—MORNING.

The meeting was called to order at 10:30 o'clock, on the morning of October 5th, at the convention hall of the Tulane Hotel, the President, August Hermann, in the chair.

THE PRESIDENT: The members of the society will please come to order. Mr. Kennedy, our Treasurer, desires to make an announcement.

MR. KENNEDY: Ladies and Gentlemen of the Society: It has been my pleasure to receive you here this morning, and I want to present our Governor, who will deliver to you an address of welcome to our State. Mr. President and Gentlemen: I present you to Governor Robert L. Taylor, of Tennessee.

GOV. ROBERT L. TAYLOR: Mr. President and Gentlemen of the American Society of Municipal Improvements: I have only appeared amongst you to-day to give you a cordial greeting and a hearty welcome to the greatest State in the Union. The objects of your organization, as I understand them, are to give to the cities and towns of our country better ideas for the protection of the health and for the comfort and happiness of the people. If you can show us, who burn soft coal, how to get rid of smoke and soot, and then discover a plan to make us adopt measures to do so, I know thousands of people who will fall down on their knees and call you blessed. If you can, in your united wisdom, devise a plan by which we can get clean water—I don't mean Nashville water (laughter)—and clean streets and thorough drainage, and then invent some law, like the law of the Medes and Persians, to compel us to drain and clean without having our hats and bedclothes levied on for taxes, we will worship you as the heathens worship the Nashville Sun. I would respectfully suggest that the best possible movement that could be inaugurated to reach the best possible improvement to our cities and towns, with the least possible expense to the people, would be to begin this glorious work by ridding the municipalities of our chinquepin ward politicians and chestnut editors who want fame and fortune by scalping the commonwealth and snatching Mayors and Governors bald-headed who refuse to give down the milk.

There are many questions of vital importance to the whole country which must necessarily arise for your consideration, questions of sanitary improvement, for the protection of communities against disease; questions of street paving; questions of the abatement of nuisances which occur on the alleys and thoroughfares of every municipality, from the smallest village to the largest city, and upon the successful solution of which depends, not only the health and happiness of the inhabitants, but the growth and prosperity of the cities themselves. These questions, involving the homes and lives of so many millions of our people, appeal to the best thought and experience of the Nation, and open the way for the advance of a better and higher civilization, and I am constrained to believe, judging from the personnel of this splendid body of men, that the advance guard of municipal improvement in America have gathered here to-day.

It affords me especial pleasure to give you a hearty welcome to our midst, and to bid you God-speed in the glorious work which you have so nobly undertaken. You deserve the coöperation and encouragement of all good people everywhere, and I trust that the fruits of your labors may be the blessings and benedictions of millions to whose happiness you have contributed, and an eternal citizenship in that city where there is neither smoke nor taxes, and whose streets are paved with gold! (Applause.)

MR. KENNEDY: We also have with us this morning Hon. A. S. Williams, the President of the City Council, who desires to welcome you on behalf of the city of Nashville.

COUNCILMAN WILLIAMS: Mr. Chairman, Governor Taylor, and Gentlemen representing the American Society of Muncipal Improvements: Governor Taylor has very cordially and sincerely extended to you a hearty welcome to the great State of Tennessee, which he was happy to denominate the greatest State in the United States. It now becomes my feeble duty, Mr. Chairman, in behalf of the municipality of Nashville, to extend to you a cordial welcome to all the rights, friendships, privileges and hospitality that ever characterized the citizenship of this town, the grandest in the United States!

It is a universal prerogative of our city, made more especially so since the inauguration of our Centennial Exposition—I say it has become proverbial that the citizens of Nashville are qualified, in every detail, to extend a cordial welcome and a friendly greeting to every association and society that honors us—that is, every worthy association and society—that has honored us with their presence during this time.

Referring to our municipality, Mr. President, we point with pride, sir, to a charter framed solely and absolutely for the public weal, possessing all the attributes that are necessary to deal and mete out equal justice to all—the "Sun," the "American," and the "Banner," and every individual citizen of our community. The ship, however, Mr. Chairman, may be complete, the water ample, but a reckless or a vicious pilot could sink the ship.

I hail with delight, sir, and pleasure, the assembling of your association in our midst, and say to you, representing my friend, Col. Kennedy, of the Board of Public Works and Affairs, and Mr. Stainback and Mr. Beasly, his worthy associates, that they will stand ever ready to expose to your critical view every detail of our system, and accept with gratitude any suggestion that may come from this body of combined intelligence looking to its improvement. (Applause.)

I believe I express the sentiments of the citizenship of our city, when I say it is the object and purpose, sir, of every honorable man within the confines of the corporate limits to see the laws and the principles so executed that equal justice may be meted out to all and favoritism to none.

When I behold, sir, the expression in the faces of the gentlemen composing this association, I feel called upon to congratulate the country upon the existence of this most worthy association, and to say, sir, that I look forward to a no distant day when the municipalities—and, and pardon me, sir—that are so much susceptible of improvement, may have the benefit of the combined wisdom of this society, and that you, gentlemen, will have the happy conscious reflection of a duty well spent and of a service rendered your fellow-men, that will live long after you have passed across the river to the great hunting grounds of the hereafter.

My friends, and Mr. Chairman, we welcome you to all the rights and privileges of our city, and bid you that God-speed in all the laudable undertakings of your society that should rest upon the virtuous and honorable. (Applause.)

THE PRESIDENT: Governor Taylor, and Mr. Williams: On behalf of the American Society of Municipal Improvements, I desire to return our thanks for the very cordial greeting and welcome that you have extended to us this day. We have assembled in your city for the purpose of exchanging views and discussing matters pertaining to municipal affairs of all kinds.

While our association is yet in its infancy, I feel warranted in saying that we have already accomplished some good in the direction in which our work is aimed, and that to some extent this fact has been recognized and appreciated throughout this country.

Our main object is to devise, and by mutual advice and counsel to determine, the best methods to be employed in administering the affairs of the public in the interest of those whom we may have the honor to represent.

It is our hope and expectation that during our short stay in your city something may develop, during our deliberations, that will be of benefit to your municipal officers and to your people in general.

I know of no better way that we can show our appreciation for the welcome and kind fellowship that you have extended to us this day than to say to you on behalf of the members of the American Society of Municipal Improvements, individually and collectively, that our best wishes are with you, for the future prosperity and the continued advancement of your City and State in the new era in which you have entered.

I desire, again, to thank you for your very cordial welcome. (Applause.)

Gentlemen of the Society, the first thing in order is the calling of the roll, and the reading of the minutes of the last meeting.

MR. HORNER, Parkersburg: Mr. President, if it is not proposed to read the minutes of the last session, I move that the reading of the minutes be dispensed with. Motion carried.

THE PRESIDENT: The next thing in order is the consideration of applications for membership. Mr. Secretary:

THE SECRETARY: Mr. President, we have, since our last meeting, the following names of those who have made applications for membership in this Society:

George A. Vandergrift, Member Board Administration, Cincinnati, O
C. G. Swensberg, Pres. Board of Public Works, Grand Rapids, Mich.
Hon. Jere Gallagher, Mayor of Quebec, Canada.

Hon. Samuel Bingham, Mayor of Ottawa, Canada.

Frank B. Rae, C. E., Consulting Engineer, Chicago, Ill.

Charles McMillan, Esq., City Clerk, Calgary, Prov. of Alberta, Can.

E. G. Barrows, C. E., City Engineer, Hamilton, Canada.

Julius Wurzburger, Assistant Street Commissioner, St. Louis, Mo.

G. C. Langenheim, C. E., City Engineer, Allegheny, Pa.

J. Linwood Brown, Supt. Water Department, Allegheny, Pa.

David Hunter, Jr., Superintendent Light Plant (city), Allegheny, Pa.

S. A. Taylor, C. E., Consulting Engineer, Pittsburg, Pa.

Harvey J. Wiley, Esq., Secretary Street and Sewer Commissioners, Wilmington, Delaware.

Philip Justus. Member Board Public Works, St. Paul, Minn.

Thomas McMillan, Esp., Board of Public Works, Rochester, N. Y.

Edwin A. Fisher, City Engineer, Rochester, N. Y.

Augustus Dupont, Dupont, Ga.

C. C. Martin, Member Board of Trade, Parkersburg, W. Va.

Charles F. Herr. Member Street and Water Commissioners, Newark, N. J.

MR. VAN DUYNE, Newark: I would like to propose the name of Charles F. Herr, of the Board of Public Works, of Newark, N. J.

JOHN COPELAND, St. Paul: I would like to propose the name of Phillip C. Justus, Member of the Board of Public Works, St. Paul.

THE PRESIDENT: You have heard the reading of the applications for membership, what is the pleasure of the convention?

On motion of Mr. Kennedy, duly seconded, the applications were accepted, and the applicants elected to membership in the society.

THE PRESIDENT: The constitution provides, among other things, for an annual address by the President, and, with your permission, I will proceed.

THE PRESIDENT'S ANNUAL ADDRESS.

TO THE MEMBERS OF THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS:

The objects of this society can not be better stated than in the language of its constitution, viz:

"To disseminate information and experience upon, and to promote the best methods to be employed in, the management of municipal departments and in the construction of municipal works, by means of annual conventions, the reading and discussion of papers upon municipal improvements, and by friendly and social intercourse at such conventions, and to circulate among its members, by means of an annual publication, the information thus obtained."

We have met to-day to commence the proceedings of our fourth annual convention.

When the first call was issued, three years ago, for the formation of this organization, many who had received invitations to attend doubted whether a society of this kind could be permanently and effectively established, and if the results to be attained would be of any material benefit to either an individual member or a municipality that might acquire membership therein.

When we met in the city of Buffalo at that time, seventeen cities were represented by fifty-seven delegates. Without even fully organizing, we met a year later at Cincinnati, with forty-eight cities represented and one hundred and twelve delegates in attendance. Last year at Chicago our membership had increased to sixty-four cities and one hundred and sixty-three members, and I will venture to say before we leave the city of Nashville we will have increased our representation to no less than seventy-five cities and two hundred members.

What better indication can there be than in the growth of the society itself, that the permanency thereof has been established beyond any doubt; that its usefulness and importance has been recognized and appreciated; and that in the near future it is destined to become the most important municipal organization in this country? For this reason, if for no other, I desire to extend to you my hearty and sincere congratulations.

I dare say that there is not a municipality in this country whose form of government is so perfect, or whose public officials are so conversant with carrying the same into effect, and with properly executing the powers and duties devolving upon them by law or otherwise, that cannot be enlightened in some form or other, in matters pertaining to their municipal affairs; nor is there a city in this country whose citizens and officials are not, at some time or other, seeking information, with a view of securing broader and clearer ideas looking to the betterment of practices in vogue necessary to not only maintain but improve the health, cleanliness, appearance, comfort and general conditions of their respective communities, in so far as municipal affairs are concerned; and, in either case, I know of no better medium for securing this knowledge, and receiving the benefits of the most modern practices of other cities relative thereto, than by acquiring a membership in this society.

The usefulness of an organization of this kind cannot be estimated. Some of the benefits that may be obtained by acquiring a membership therein have been repeatedly pointed out by former Presidents and other officials of the society, as well as by the members themselves. This has also been done by nearly all of the municipal magazines of the country, and, in addition thereto, by a number of the leading daily newspapers.

It has been said that we cannot, with better effect, get at the experiences and best practices of other cities, with respect to all matters pertaining to municipal affairs, "than through the medium of this organization, with its annual gatherings and opportunities for personal acquaintanceship."

I desire to say, in this connection, that I consider the personal acquaintanceship which is formed by municipal officers in an organization of this kind a most important factor to any official in securing data and information relative to any duty or public matter with which he may be entrusted.

In the larger cities of the country public officials are subjected to constant, and, in a great many instances, unwarranted criticism. Public improvements, specifications, contracts, rates and methods of taxation, modes of assessment, water rents, value of franchises, and numerous other municipal matters are constantly made the subject of comparison with other cities, oftentimes with a view of impressing the public that their officials are negligent, incompetent, extravagant, or even worse. No matter how competent and efficient an official may be, he finds himself confronted with "facts and figures" (this is the term generally applied) that he can not explain satisfactorily until he has made a careful analysis and research of the methods and conditions in vogue in the cities that are presented to his constituents for comparison with his own. It is a very easy matter to say that the rate of taxation in one city is twenty-five dollars on each thousand dollars' worth of taxable property, while in another it is only twenty dollars, and thereby create unfavorable comment; but when the subject is analyzed, and it is found that in the first instance taxable property is assessed at fifty per cent of its value, while the latter is assessed at seventy-five per cent. of its value, it can as easily be shown that the twenty-dollar rate, under those conditions, is higher than the twenty-five dollar rate. I remember a few years ago a gentleman came to Cincinnati from the city of Washington, to take charge of one of its daily newspapers there, as managing editor thereof. He had not been in Cincinnati very long until he received the water rent bill for his residence. A comparison of the bills paid by him in Washington for the same-sized house showed that the Cincinnati rate was about thirty-three per cent. higher than the Washington rate. Without seeking any explanation, he at once made an attack on the Water Department. But when it was shown that the city of Washington received its water by gravity, and that for the larger portion of the city no pumping was required, while in Cincinnati it was necessary to first pump the water to a reservoir, to a height of two hundred and forty feet, and then to pump it a second time, to an additional height of two hundred and thirty feet to a water tower, in order that he might receive his supply, which meant increased cost, he was satisfied.

Therefore, I say, it is this personal acquaintanceship that municipal officers form in an organization of this kind, that becomes an important factor to you in obtaining knowledge on municipal affairs in general, not only, at the annual meetings, but it enables you at any time to communicate with your fellow members and secure information on any subject in which you may be interested. My experience as a public officer has been that previous to our organization it was almost impossible to secure information pertaining to public affairs from other cities, unless it was done through a personal investigation involving both time and money. We did not know with whom to correspond, and as a rule, even if we did, no attention was paid to our requests. We are enabled to-day, through this organization, and the acquaintance we are given the opportunity to form with the members thereof, to put ourselves in touch at any time, with any of its members, on any municipal subject pertaining to their respective cities, and receive, not only careful and accurate information, but receive it promptly as well.

You will notice from the manner in which the programme pertaining to the business of the convention has been arranged, that all papers to be presented for the consideration of the society are to follow the reports of the standing committees on the particular subjects to which they may refer, and I would suggest, if any member desires to submit any additional papers on any of the subjects for which standing or special committees have been heretofore created, and which do not appear on the programme as printed, that he present the same in the order in which the reports of the committees are received, and in order to expedite the business of the convention, that the same mode of procedure, with respect to the discussion of reports or papers, be followed, as was the case a year ago, viz: That the reports of committees be first read, that thereupon all papers pertaining to the subject-matter be presented; that the members take notes as to any questions they may desire to ask; referring to papers by titles; and that, upon the completion of the reading of the reports and the papers submitted in connection therewith, the discussion relative thereto be taken up and finished before a new subject-matter is entered into.

I would respectfully suggest that the Committee on Taxation and Assessment, to be appointed for the ensuing year, take uo and submit a report at the next meeting of the society, showing the rates of taxation throughout the leading cities of the country—this report to show, among other things, the percentage of value of real estate as placed on the duplicate for taxation in the various cities, the tax rate in each city, as well as a division thereof showing separately the rate for municipal, county, state, educational, sinking fund and interest, special, and all other purposes that go to make up the grand total. Such a report, it seems to me, will be of incalculable benefit to the members of the society, and will materially aid us at all times in making intelligent comparisons of the tax rates of our respective cities with those of other cities to be presented in the report.

In my judgment, there is no question concerning municipal affairs that is receiving more attention throughout the country to-day, not only by public officials, but by the citizens and press of the various municipalities as well, than that of "Municipal Franchises." I would, therefore, suggest and recommend that an additional standing committee be created, to be known as the Committee on "Municipal Franchises," and that this committee, when appointed, be instructed to take such steps as may be necessary to enable it to present for the consideration of the society, at its next annual meeting, a concise statement or report (taking as a basis twenty or thirty of the larger cities of the country, and the franchises known as Street Railway, Gas and Electric Lighting, Telephone and Telegraph, and such other important franchises as they may deem expedient), showing, among other things, the laws and ordinances under which franchises of this character are granted; the officers empowered with the duty to grant them; the conditions exacted from the beneficiaries, as to street maintenance, construction, etc.; the revenues derived from the grants; the rates of fare or other charges permitted thereunder; the period of the grants; and such other important features as in the judgment of the committee may be of value. By this method the problem of municipal franchises can be considered in an intelligent manner at our next meeting.

I would further recommend that a special committee, to be known as a Committee on "Municipal Data," be appointed, and that this committee be instructed to formulate a plan providing for the enactment by Congress of the necessary legislation looking toward the more complete establishment and maintenance by the Government of a "National Bureau on Municipal Data," with a view of having collected through it annually, and formulated for publication and distribution, a complete report with respect to municipal and public work of all kinds; showing the kind and quality of material used; the methods employed; the comparative cost thereof; the results obtained; the manner of using it; the conditions under which the work has been done; the manner of payments and guarantees, and such other information of importance relative thereto as the committee may deem advisable. The same to be submitted for the consideration of the society at its next annual meeting; and if it meets with the approval of the society, that such steps be taken at that time as may be necessary with a view of having the same transmitted to Congress with a recommendation that laws be enacted to put the same into effective operation.

In conclusion. I desire to extend my thanks, first, to all of the members of the various standing and special committees, as well as those members of the society who have prepared papers for our consideration at this convention. for their efforts and labors in that behalf; to the Executive Committee. and officers of the society, and especially the Secretary, for the assistance they have rendered me as your presiding officer during the past year: and the members in general for their attendance here to-day. as well as for their endeavors to secure additional members for the society. and to promote its interests in general; and I urge upon you. one and all. to go forth during the coming year with renewed earnestness upon your part, to impress, not only upon your constituents, but the people in general, and municipal officers in particular, the importance and usefulness of this society, to the end that in the near future the American Society of Municipal Improvements shall be looked upon and recognized throughout America as the fountain head to which municipal officers shall look for the most modern practices with respect to the management of municipal affairs, and the application thereof in the most economical and satisfactory manner.

I thank you for your attention.

THE PRESIDENT: The next thing in order is the report of the Secretary.

REPORT OF THE SECRETARY.

OCTOBER 5, 1897.

TO THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS, ASSEMBLED IN THE CITY OF NASHVILLE, TENN.:

SIRS:

I have the following report to make:

Being duly elected by your Honorable Body at your last meeting in Chicago, Ill., I took charge of the minutes of the last meeting. With the assistance of the President they have been published in pamphlet form and distributed to the several members of the society.

This report was taken in charge by our Honorable President, and, with a great deal of labor, has been perfected and published in its present shape after receiving bids from several parties.

Miss Emma Jacobson, of Chicago, took charge of the stenographic work, and for her service and transcripts of the last convention the society paid her $139.00. I would say that her work was very nicely and quickly done.

The society was at an expense last year which it will not have to bear for some time, viz: the lithographing of 1,000 certificates of membership, which cost $125.00.

The printing of the annual report was done by the Swain & Tate Co., of Milwaukee, at a cost of $440.75.

The amount of money collected by the Secretary was $662.02, which is divided as follows:

Membership fee from 18 cities at $5.00	$90.00
Members' dues, at $3.00, from 154 members	462.00
72 membership certificates were issued at $1.00	72.00
18 reports of the year 1895 were sold at 25 cents	4.50
33 reports of 1896 were sold at $1.00	33.00
Incidental amount received	.52
Total	$662.02

Receipts from all sources were $1,156.99.

Notices of the present meeting have been sent to the councils of all cities in the United States of 5,000 inhabitants and over, inviting them to send delegates to attend this convention. Invitations have also been sent to over two hundred city officials, not members of this society, who have had correspondence with the Secretary during the past year.

A number of personal letters have been sent to the larger Southern cities who had not before been members of this society, inviting them to send their city engineers and as many of their other officials and councilmen as possible to attend this convention.

The interest in the working of this society may easily be seen from the fact that the society has sixty-four cities represented among its members.

There are many city officials who would gladly attend these conventions if their councils and public works departments would pay their expenses, which should be borne by the city they represent, from the fact that the city itself is the one profited by their attendance.

Many members living at a distance do not feel able to bear the expense attending our conventions, and if our cities were aware of the vast amount of information to be gained they would be willing to send several representatives, and think the money well spent.

According to a resolution passed at the last meeting, one annual report was sent to the Mayor of each city represented in the society, which amounted to sixty-four in all; a note was enclosed asking the Mayor to call the attention of the proper officials to the good work which is being done by our society.

Respectfully submitted,
D. L. FULTON,
Secretary.

THE PRESIDENT: You have heard the report of the Secretary. What is the pleasure of the convention?

MR. COPELAND of St. Paul: I move that it be accepted and placed on file and printed in the annual report. Motion carried.

THE PRESIDENT: The next thing in order is the report of the Treasurer. Mr. Kennedy:

The Treasurer here read his report as follows:

TREASURER'S REPORT

TO THE HONORABLE, THE FINANCE COMMITTEE OF THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS, IN SESSION AT NASHVILLE, TENN., OCTOBER, 1897:

The undersigned hereby exhibits an account of his receipts and expenditures as Treasurer of the said society during the second year in which he has served in that capacity, beginning October 14th, 1896.

It must first be stated that Mr. D. L. Fulton, your Secretary, from the cash which he received in his official capacity, paid two accounts on October 21st, 1896, and sent the receipts therefor to your Treasurer.

These accounts were duly approved by Mr. Herrmann, President, and by Mr. Fulton, Secretary, and their payment was legally authorized and was in every respect proper, but as the cash with which they were paid was not actually received by your Treasurer, he does not charge himself therewith.

These accounts were, (1) an account due to T. A. McNary, of Allegheny, Pa., for circular letters, envelopes postal cards, programmes, receipt books, etc., of use of the society, $57.25; (2) an account due to D. L. Fulton, for his salary as Secretary of the society, one year ending October 16th, 1896, $100.00; and for sundry items, including postage stamps, money box, record book, etc., for use of society, $22.09, a total of $122.09.

These said two accounts aggregate ($179.34) One Hundred and Seventy-nine and 34/100 Dollars.

The cash actually received and disbursed by your Treasurer is shown as follows, viz:

Cash Receipts.

1896.		
Oct. 14th	Am't cash on hand as per settlement approved by your Finance Committee	$192.24
Oct. 24th	From D. L. Fulton, Sec'y, as per letter Oct. 22d	328.91
Nov. 24th	From Aug. Herrmann, Pres., as per letter Nov. 22d, for copies of report	103.00
Dec. 7th	From Aug. Herrmann, Pres., as per letter Dec. 5th, for copies of reports	75.00
Dec. 31st	From Aug. Herrmann, Pres., as per letter Dec. 2d, for copies of report	23.00
1897.		
Jan. 4th	From D. L. Fulton, Sec'y, as per letter Jan. 1st	82.50
Jan. 9th	From C. C. Brown, for copy of annual report	1.00
Jan. 15th	From Capt. L. A. Beach, refunding in stamps amount of actual account paid Jan. 11th	.07
Jan. 21st	From Aug. Herrmann, Pres., as per letter Jan 20th, for copies of reports	3.00
Jan. 23d	From Aug. Herrmann, Pres., as per letter Jan. 22d, for copies of report	18.00
Feb. 25th	From Aug. Herrmann, Pres., as per letter Feb. 24th.	1.00
	And from him per second letter of same date, for copies of report	53.00
Feb. 27th	From Aug. Herrmann, Pres., as per letter of Feb. 26th, his personal check for money advanced by him for use of the society	150.00
Mar. 1st	From D. L. Fulton, Sec'y, as per leter Feb. 26th	28.00
April 7th	From Aug. Herrmann, Pres., as per letter April 6th, for copies of reports	55.00
May 17th	From D. L. Fulton, Sec'y, as per letter May 14th	30.02
		$1,143.74
Sept. 13th	From D. L. Fulton, Sec'y, as per letter Sept 11th	13.25
		$1,156.99

Disbursements.

1896.		
Oct. 24th	Paid G. H. Benzenberg's account, for money expended for society for railroad agent telegram, printing and express charges for year 1896. Approved by Aug. Herrmann, Pres	$21.20

Oct. 24th...	Paid Milwaukee Lithographing and Engraving Co. account for 1,000 membership certificates. Approved by Aug. Herrmann, Pres., and D. C. Fulton, Sec'y.	125.00
Oct. 24th...	Paid expense account of Committee on Electric Street Lighting. Approved by Aug. Herrmann Pres.	84.75
Nov. 11th..	Paid Marr and Richards' account for society seal. Approved by Aug. Herrmann, Pres., and D. L. Fulton, Sec'y	6.00
Nov. 11th..	Paid Miss E. Jacobson's account, for transcribing society proceedings. Approved by Aug. Herrmann, Pres., and D. L. Fulton, Sec'y..................	139.80
Dec. 4th....	Paid Commercial Gazette Job Printing Co.'s account for stationery, etc. Approved by Aug. Herrmann, Pres., and D. L. Fulton, Sec'y....................	14.50
Dec. 10th...	Paid T. A. McNary's account, for printing. Approved by Aug. Herrmann, Pres., and D. L. Fulton, Sec'y	9.25
1897.		
Jan. 4th....	Paid D. L. Fulton's account, for stationery, expressage, stamps, certificate. Approved by Aug. Herrmann, Pres., and D. L. Fulton, Sec'y............	16.01
Jan. 11th...	Paid Commercial Gazette Job Printing Co.'s account, for circulars, etc. Approved by Aug. Herrmann, Pres., and D. L. Fulton, Sec'y.............	2.85
Jan. 11th...	Paid Norris Peter's account, lithographing and painting. Approved by Aug. Herrmann, Pres., and D. L. Fulton, Sec'y............................	14.00
Jan. 11th...	Paid Capt. L. H. Beach (government engineer) for printing copies of "Tree-root from Sewer Pipe." Approved by Aug. Herrmann, Pres., and D. L. Fulton, Sec'y	3.25
Jan. 11th...	Paid Franklin Engraving and Electrotyping Co.'s account, for circulars, postage, etc. Approved by Aug. Herrmann, Pres., and D. L. Fulton, Sec'y..	131.90
Jan. 11th...	Paid Gibson & Sorin Co.'s account, for circulars, postage, etc. Approved by Aug. Herrmann, Pres., and D. L. Fulton, Sec'y.........................	10.20
Jan. 16th...	Paid T. A. McNary's account, for labels, etc. Approved by Aug. Herrmann, Pres., and D. L. Fulton, Sec'y	5.13
Jan........	Used for postage..............................	.07

Feb. 27th	Paid Swain and Tate Co.'s account, for printing copies of proceedings of third annual meeting, etc. Approved by Aug. Herrmann, Pres.	440.75
April 29th	Paid T. A. McNary's account, for slips, maps, etc. Approved by Aug. Herrmann, Pres., and D. L. Fulton, Sec'y	6.00
May 17th	Paid D. L. Fulton's account, for certificates, stamps, expressage, etc. Approved by Aug. Herrmann, Pres	26.48
		$1,057.14
Sept. 30th	Paid Aug. Herrmann's account	73.92
		$1,131.06

RECAPITULATION.

From the foregoing statement it will be seen that Mr. D. L. Fulton, Secretary of the society, has received from various sources cash	$662.02
And has disposed of the same by paying approved accounts	179.34
And remitting to your Treasurer	482.68
	$662.02
Mr. Aug. Herrmann, President of the society, has received from various sources, for extra copies of the reports of the annual meeting held in Chicago, in October, 1896	$331.00
And has advanced for use of the society, cash to the amount of	150.00
All of which has been paid over to your Treasurer, amounting to	$481.00

Your Treasurer has received from all sources, cash as follows, viz:

From D. L. Fulton, Sec'y	$482.68
From Aug. Herrmann, Pres	481.00
From C. C. Brown, for copy of report	1.00
From Capt. L. H. Beach, P. O. stamps to correct error in account	.07
Amount on hand and in treasury at time of previous settlement	192.24
Total cash to be accounted for	$1,156.99

Your Treasurer has paid sundry accounts and expenses, as shown in the preceding statement, to the amount of $1,131.06, which leaves a balance in the hands of the Treasurer to the amount of $25.93.

The society is indebted to Hon. Aug. Herrmann for money advanced by him February 27th, 1897, as hereinbefore shown, $150.00.

The above amount of $25.93 is to the credit of your Treasurer in the Fourth National Bank of Nashville.

All of which is respectfully submitted, this October 5th, 1897.

JOHN L. KENNEDY,

Treasurer of American Society of Municipal Improvements.

Mr. Kennedy: The item from Mr. Herrmann ($150.00) refers to money advanced by Mr. Herrmann by his personal check to meet the expenses of the society. There have been two or three little accounts come in this morning which will be reported on hereafter.

The President: Is the Finance Committee ready to report?

Mr. Rundlett, Chairman of the Finance Committee: The Finance Committee had really but a few minutes this morning to check over that report, and we will submit the following, and, if we find it necessary, we will submit a further report:

REPORT OF FINANCE COMMITTEE.

American Society of Municipal Improvements:
Gentlemen:

Your Committee on Finance would report that they have examined the report of the Treasurer, checked up the receipts and vouchers for disbursements. and find the same to be correct.

The Treasurer's books show that there is apparently now on hand in the treasury a balance of $25.93; and we find, on further investigation, that there is an outstanding indebtedness as follows:

Secretary's salary	$100.00
President August Herrmann, for money advanced	150.00
Sundry small bills	16.36
Being a total deficiency of	$266.36

You will remember that the last year's report of the Finance Committee showed a deficit of $233.30, so that, during the past year, receipts have fallen short of expenditures $33.06.

The principal item of expenditure is the printing of the annual reports, which cost, this year, nearly $700.00.

There were received from copies of the reports sold to outside parties, $330.00.

The committee also find that out of the total disbursements of $1,310.40, nearly a thousand dollars was expended under the items of printing and stationery, which seemed to the committee a very large amount, but we are assured by the officers of the society that this was largely due to the additional maps and charts required for the annual report, and the expenditure for this purpose another year will be much smaller. But even with a reduction in this amount, it is quite evident that the society, in order to get out of debt, must in some way curtail expenses during the coming year.

Your committee estimate that the total revenue from certificates of membership and membership dues will not probably exceed $600.00.

The only fixed charges of the society are the Secretary's salary of $100.00. The balance of the expenditures is in the hands of the executive officers, and your committee would recommend to these officers that they curtail the expenses to fit the income, and that every effort be made by individual members to increase the membership of the association.

Respectfully submitted,
L. W. RUNDLETT,
F. J. O'BRIEN,
Committee.

THE PRESIDENT: Gentlemen, you have heard the reading of the reports of the Secretary and Treasurer—what is the pleasure of the convention?

MR. BOYNTON, Davenport: I move that the reports be accepted, filed and printed.

MR. ANDREW ROSEWATER, Omaha: I should think that the printing of a report of this kind would be of no benefit. It would simply incur expense unnecessarily, especially at a time when you want to curtail the expenses. I would suggest that these reports to be filed and not be printed. What we want in these publications, that go abroad, is the public matters of benefit to the different cities. Matters of this kind have no interest to outsiders, and are of no interest except to the committee men who manage these affairs. I move that this report be accepted and filed. I offer that as an amendment.

THE PRESIDENT: It has been offered as an amendment that the report be filed but not printed.

A DELEGATE: Isn't it true that if the maps which were included in the last report hadn't been published, the receipts would have been equal to the expenditures, and that this will probably not occur again?

THE PRESIDENT: There is no question about that. The Electric Light Committee used, last year, nearly $90.00; I understand there is no expense, this year, in that direction. It seems to me reports of this kind, bearing on the condition of the society, ought to be embodied in the annual report. It is a very small matter, and I do not think the two reports would cover ten pages.

MR. THOMPSON, Peoria: I think the reports are read here in the meeting, and we only hear them at the meeting, some of the members are not here even, and when we are here, we haven't the time to examine into these reports. The first thing I do when I receive the printed reports is to look through the reports of the various committees, to see what the society is doing. I think it would be very foolish indeed to curtail the expenses by eliminating these reports from the published proceedings of the association.

MR. BENZENBERG, Milwaukee: I think the financial reports of this society ought to be printed in the proceedings if we print nothing else. We should place the financial condition and the expenditure of money before the membership. I think that if you leave it out it will establish a precedent that some time will trouble the society very much.

MR. F. J. O'BRIEN, Oswego, N. Y.: I think just as Mr. Benzenberg does; it should be published, so that the people at home whom we represent could see what we are doing with the money, and just what it costs to run this or any part of it.

THE PRESIDENT: Does any one second the amendment? If not, we will take up the motion as originally put, that the reports be received and filed and printed in the annual report.

Adopted.

THE PRESIDENT: The next thing in order is the reading of the report of the Executive Committee.

MR. BENZENBERG: My train was an hour late, and I was unable to be present at the meeting of the Executive Committee; I understand, however, that the Committee had a meeting.

THE PRESIDENT: You say they did have a meeting?

MR. BENZENBERG: I was so informed; if they have not, there will be a meeting called to-day, at about the noon hour.

On motion of Mr. O'Brien the Executive Committee was allowed further time in which to make its report to the society.

THE PRESIDENT: That is the only business we have for this morning. For the afternoon we have the report of the Committee on Street Paving and quite a number of papers. In that connection I respectfully request that the members be here promptly at two o'clock, and that they remain with us. You will notice we have two days to visit the exposition—we don't want to go there to-day, and be handicapped by having a small attendance in the afternoon.

MR. MCMILLAN, Rochester, N. Y.: The report of the President was passed by in silence. There are suggestions of value to the association in it, and I move that the report be received, filed, and printed in the annual report, and that the suggestions therein be referred to the Executive Committee.

MR. ERNST ADAM, Newark, moved to amend by saying that the addresses of the President of the Common Council and of the Governor and the annual address of the President of the society be printed in the report, and that the President's address be referred to the Executive Committee.

MR. O'BRIEN: That is, the suggestions contained therein.

This motion, meeting with a second, was adopted.

THE PRESIDENT: That finishes the business for this morning, and after we adjourn I kindly request that those who have not seen the Secretary will do so as soon as possible, in order that we may know where we stand financially.

THE SECRETARY: I will say I brought along a number of our annual reports for 1895 and 1896, and any new members who have not had any of these annual reports can have them by paying the price that is fixed.

THE PRESIDENT: The price is one dollar. Of course the new members know that after they acquire a membership in the society one copy of the annual report is furnished them gratis.

The convention here adjourned until 2 o'clock p. m.

TUESDAY, October 5th, 1897.

AFTERNOON SESSION.

The afternoon session was called to order by President Herrmann at 2:35 p. m.

The report of the Executive Committee was read by the Chairman, Mr. Benzenberg, of Milwaukee.

REPORT OF EXECUTIVE COMMITTEE.

NASHVILLE, TENN., OCTOBER 5TH, 1897.

TO THE MEMBERS OF THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS:

GENTLEMEN:

Your Executive Committee submits for your consideration the following report:

On September 25th, 1897, your committee transmitted the following communication to the proposed convention of Mayors and Councilmen, which explains itself:

TO THE OFFICERS AND DELEGATES ASSEMBLED AT THE NATIONAL CONVENTION OF MAYORS AND COUNCILMEM, COLUMBUS, O., SEPTEMBER 28TH, 1897:

CINCINNATI, O., SEPT. 25TH, 1897.

GENTLEMEN:

The atention of the undersigned, the Executive Committee of the American Society of Municipal Improvements, has, through an invitation to participate in the proceedings thereof, been called to the proposed national convention of Mayors and Councilmen, to be held in the city of Columbus, O., from September 28th to October 1st, 1897, inclusive.

This Committee desires, in behalf of its members, to extend its thanks for such invitation, but regrets, however, that they will not be able to attend the proposed convention, for the reason that they are now, and have been for some time past, engaged in preparing a programme and making the necessary arrangements for the fourth annual convention of the American Society of Municipal Improvements, which convenes in the city of Nashville, commencing October 5th, 1897.

The object of your proposed organization meets with our unqualified endorsement.

The question arises, however, as to whether it is advisable to permanently establish two national associations with practically the same objects in view. In this connection, we desire to submit for your consideration:

1st. A copy of the constitution of the American Society of Municipal Improvements.

2d. A list of the cities, as well as the names of the individuals, who have already acquired a membership in this society.

3d. A number of copies of the proceedings of the last annual convention of the society.

4th. A number of copies of the programme for the next annual meeting of the society.

It will be observed that the objects of the American Society of Municipal Improvements, as well as the eligibility of acquiring a membership therein, are practically the same as those set forth in your preliminary call.

From the number of cities, as well as members, who have acquired a membership in our society, it is apparent that we have established, not only a permanent organization, but an examintion of the annual reports of former meetings will show that we have established a useful and important association as well.

In our opinion, it would be far better for all persons interested, if municipal officers of every character could be grouped or banded together in one permanent organization, rather than in two organizations with practically the same objects in view.

It is the intention of our society to so arrange its work in the future that it may be divided off in sections. Thus, if a convention is called, the work of which will require from six to ten days, it can be so apportioned that such members of the society as so desire need only attend on those days of the annual conventions at which subjects or sectional work in which they are particularly interested are presented for consideration and discussion, thus saving a great deal of time, and at the same time giving them the benefits of the proceedings of the entire session through the publication and distribution of the annual reports.

If, after the consideration of the matters presented by us herein, it is your opinion that another organization should be established, we respectfully suggest that you take such action as will provide for holding your next convention at the same time and place as that of our society, thereby enabling all parties interested to more fully and intelligibly discuss the suggestions that we present for your consideration.

Respectfully transmitted to the proposed convention of Mayors and Councilmen. Columbus, O., Sept. 28th, 1897, by the Executive Committee of the American Society of Municipal Improvements.

AUG. HERRMANN,
Chairman.

E. B. GUTHRIE, Buffalo, N. Y.,
WM. D. KERR, Chicago, Ill.,
ERNEST ADAM, Newark, N. J.,
D. L. FULTON, Allegheny. Pa.,
JOHN L. KENNEDY, Nashville, Tenn.,
G. H. BENZENBERG, Milwaukee, Wis.,
AUG. HERRMANN, Cincinnati, O.
Executive Committee of American Society of Municipal Improvements.

Your committee reports that it has received no official reply to this communication.

(MR. BENZENBERG: Mr. President—You will pardon me if I say that I have, shortly before leaving home, received information from one who attended that convention—not the Mayor of Milwaukee, because he is loyal to this organization—but from parties who attended the meeting, that they took the communication up for consideration, and that there had been considerable dispute; that some of the Mayors were in favor of uniting with this organization, believing that it would be of interest to those assembled to have the heads of the different departments united with them in one organization, and they would ultimately have to depend upon the heads of the different departments for practical information, but the opposition to that scheme prevailed, and it was decided, as I understand, that the heads of the different subordinate departments were not wanted in that organization.) Resumes reading of report, as follows:

Your committee recommends that the Chairman of the Committee on Street-Paving be allowed $50.00 for expenses incurred in collecting data for the report of that committee.

Your committee further recommends that hereafter no expense be incurred by either of the standing or special committees until the same has been approved and authorized by the Executive Committee.

Your committee also recommends that the recommendation of the President that a standing committee known as the Committee on "Municipal Franchises" be provided for, be adopted.

We also recommend that the suggestion by the President that a special committee known as the Committee on "Municipal Data," be adopted, and that such a committee be appointed, with instructions to proceed in their work in the manner indicated in the President's annual address.

Your committee also approves of the suggestions made by the President with reference to the work to be performed by the Committee on Taxation and Assessment during the coming year, and directs that committee to proceed in the manner indicated.

To provide for the recommendations herein contained, your committee recommends that Section 4, Article 4, be amended by substituting the following so that the same will read as follows:

Sec. 4. There shall be appointed annually the following standing committees:

1. Street-Paving;
2. Electric Street-Lighting;
3. Sewerage and Sanitation;
4. Waterworks and Water-Supply;
5. Taxation and Assessments;
6. City Government and Legislation;
7. Disposition of Garbage and Street Cleaning;
8. Review;
9. Municipal Franchises.

The number on each committee shall be three, and the Chairman may add such names as he may deem advisable. Such committee, however, shall not be authorized to incur any expense to the society without previous consent of the Executive Committee.

All of which is respectfully submitted.

AUG. HERRMANN,
G. H. BENZENBERG,
ERNEST ADAM,
D. L. FULTON,
JOHN L. KENNEDY,
Executive Committee.

THE PRESIDENT: Gentlemen, you have heard the report of the Executive Committee. What is the pleasure of the convention?

Mr. Van Duyne, Newark: I move, Mr. President, that the report be received, and the recommendations be concurred in by the convention, and also that the report be printed in the annual report.

Unimously adopted.

The President: Of course the amendment to the constitution will have to go over until to-morrow. The next order of business is the report of the Committee on Street Paving. Is Mr. Thompson present?

Mr. Thompson, Peoria, Ill.: The Committee on Street Paving have been working very hard for the last three or four days. endeavoring to complete the report for this convention. There is so much data on hand which needs compiling, and from which it is desired to derive some conclusions, that we would ask to have our report continued until to-morrow morning.

The President: If there is no objection the Committee on Street Paving will be given further time. The first paper to be presented is entitled: "The Practicability and Advisability for a City Like Minneapolis to Lay and Maintain Its Own Asphalt Pavements.'

Mr. Rundlett, St. Paul: I know it will be a source of great regret to all who have been present in previous conventions that Mr. Cappelen will not be here to read his own report, but he was detained, and at the last moment handed it to me, with the request that I read it.

The President: Before proceeding to the reading of the papers, I suggest that, should any member desire to ask any question with respect thereto, he take the name of the paper by title, and when all the papers on any particular subject are disposed of, that thereupon we proceed with the discussion thereof.

"THE PRACTICABILITY AND ADVISABILITY FOR A CITY LIKE MINNEAPOLIS TO LAY AND MAINTAIN ITS OWN ASPHALT PAVEMENTS."

BY F. W. CAPPELEN, CITY ENGINEER, MINNEAPOLIS, MINN.

Minneapolis has, at present, about eleven miles of what is usually called "Standard Asphalt Pavement," laid by three different companies, each company using a distinct kind of asphalt and mixture.

Of Trinidad Pitch Lake Asphalt there are 110,000 square yards:

Of which 28,000 yards were laid in 1890, under a five-year guaranty, at $2.75 per square yard.

Of which 12,000 yards were laid in 1891, under a five-year guaranty, at $2.75 per square yard.

Of which 10,000 yards were laid in 1894, under a ten-year guaranty, at $2.83 per square yard.

Of which 60,000 yards were laid in 1896, under a ten-year guaranty, at $2.43 per square yard.

Of Utah Wasatch Limerock Asphalt:

19,000 yards were laid in 1895, under a ten-year guaranty, at $2.49 per square yard.

Of Utah Wasatch, in combination with California Asphalt:

35,000 yards were laid in 1896, under a ten-year guaranty, at $2.38 per square yard.

The guaranty on the Trinidad pavement laid in 1890 expired in 1895, and, after the street had been put in what was considered "good repair," it was accepted, and the contractors were released from their guaranty, which consisted only of a 10 per cent. cash retainer.

The guaranty on the 1891 job expired last year. The writer refused to accept the street, and ordered the contractors to resurface same, This has not yet been done. The City Council has again ordered the street resurfaced, and an answer is expected daily from the contractors. There is about $3,600.00 cash retained by the city. In case the company should refuse to resurface, or a compromise should not be effected, the city will keep the cash and probably bring suit against the company for the balance that will be required to resurface the street, about 12,000 square yards.

During the last two years, only about $200.00 has been expended by the city for further repairs on the pavement laid in 1890 and accepted in 1895, but $2.00 to $2.25 has been the price which the city had to pay per square yard for patching the surface where holes had worn through.

The pavements laid during 1894, 1895, and 1896, have been repaired several times. The accompanying plat shows the method adopted in registering repairs, and, in this particular case, refers to Hennepin avenue pavement, laid in 1894, of Trinidad asphalt. The work was done in October and November, hence the awful amount of resurfacing required and made the next year.

The demand for frequent repairs during this season led me to think of the advisability of the city owning its own plant.

Repairs were frequently needed, more so than ever before, and particularly on the streets paved last year. Probably the uncalled for incessant flooding of the pavement by old-fashioned street sprinklers, run and operated by "Politics" beyond the City Engineer's control, had more to do with the repairs required than anything else.

The Warren Scharf Asphalt Paving Company and E. M. Ayers (using Utah and California mixture) have each a plant in the city. The American Asphalt Company (now defunct), which laid the 19,000 yards of Utah limerock asphalt, has no plant, having sold theirs to Mr. Ayers.

The Warren Scharf and Ayers companies were promptly notified to make repairs when required, and, although the specifications demand that if repairs are not commenced in six (6) days after notification by the City Engineer, the city may cause the repairs to be made by anybody and paying for the same out of the guaranty fund, the companies did not comply with the demand for several weeks. The condition of the streets grew correspondingly worse, and public kicks more frequent. Both companies were paving in other cities, and simply suited their own convenience. Meanwhile, the city had to wait. Commencing suit would not do much good. Inviting other companies to come and do the work would be equally unsuccessful, so all the city could do was to wait and grin and bear it. Asphalt pavement meanwhile getting a very black eye as a general proposition, then the advocates of vitrified brick would naturally not let such an oportunity slip by without using it to the utmost in their favor.

It is, of course, fair to presume that the condition as it existed this season in Minneapolis may be partly due to the fact that no new asphalt was laid, although bids for such work were received.

As all kinds of asphalt can now be purchased in the open market, the writer can not see any particular reason why the city should not build its own plant, buy the necessary material, and lay and maintain its own pavements. Repairs could then, of course, be made promptly and systematically, and instead of demanding the guaranty from the contractors the city would do its own pavements for considerably less first cost and assume all risks itself.

Asuming that 20,000 square yards are to be laid, the cost would be about as follows:

Trinidad:

Excavation and grading and removal of old cedar paving		10	cents per sq. yd.
6 inches concrete 1:2:5. 1 bbl. cement to lay 5.2 sq. yds		48	" " " "
Ashphalt surface, 2½ inches:			
One (1) ton asphalt, $30.00, New York as basis.			
No. 400 asphaltic cement to one (1) cb. yd of paving material, Mpls	$8.00		
No. 200 limestone dust	.20		
1 cb. yd. sand	1.25		
	$9.45		
This will lay 13 sq. yds., or 73 cents per sq. yd. for material		73	" " " "
Labor mixing		4	" " " "
" hauling		10	" " " "
" laying		6	" " " "
Superintendence		2½	" " " "
		$1.53½	per sq. yd.
Assuming plant, etc., to cost $20,000, 4 per cent. interest on 20,000 sq. yds. would be		0.4	
Or total first cost		$1.57½	

As California and Utah asphalts can be laid down in Minneapolis for about $30.00 per ton, a reduction can be made in the cost of the asphaltic surface as compared with the Trinidad of about 13 cents per square yard, or, say, a total first cost for these two classes of asphalt per square yard would be $1.45.

Bids on a five (5) year guaranty were received only a few weeks ago in Omaha, Neb., at $1.45 per square yard, if not less. As Sicily rock asphalt has been offered the writer for $8.50 f. o. b. New York per long ton, the writer feels confident that the European rock asphalts can be put down for $1.50 per square yard, first cost. As the average price per square yard of asphaltic pavements laid during 1896 in the United States, on a basis of five-year guaranty, was about $2.30, it would seem that profit, risks, and repairs would amount to about 80 to 90 cents per square yard, and the writer believes that the municipality could well afford to assume the risks, particularly as it seems to be a fact that in Buffalo, where more asphalt pavements exist than anywhere else, the repairs per square yard, after expiration of the five-year guaranty, amounts to only about 5 cents per square yard for several years.

The writer has purposely not touched upon details of plants at all. twenty thousand dollars will provide for land, tools, and a plant that can turn out 2,000 square yards asphalt surface per day.

The question of municipal ownership, considered as a whole, is of importance. and it is hoped that these remarks will be considered worthy of discussion. In connection herewith, it may be of interest to the society to know that the writer has just now finished 18,000 square yards of brick pavement on the day labor plan.

The City Council of Minneapolis, after rejecting bids three times, instructed the writer to buy the necessary material in the open market, and employ the required labor and pave Seventh street with vitrified brick.

The work has been done, the writer buying what, in his opinion, was the best brick in the Minnesota market, viz: The Purington standard repressed brick at Galesburg, Ill. The cost was as follows:

Brick, f. o. b. Mpls., per sq. yd..	87.1	cents.	
Hauling same " " " ..	3.5	"	
Laying " " " " ..	4.0	"	
Murphy grout filler " " " ..	17.5	"	
6 inches concrete " " " ..	48.0	"	(1 bbl. cement to 5.2 sq. yd. concrete.)
Sand cushion, grading, and incidentals, per. sq. yd......	7.4	"	
	$1.67½		

The last bid received for the work was $2.00. The work has been done excellently, as no pains were spared in any direction; $1.75 per day of ten hours was paid for common labor. The Purington Company also gave a personal guaranty to replace all worn out brick for a period of ten years. Des Moines brick from Iowa could have been bought for 85.5 cents per square yard, but the writer considered the Purington brick so much superior that he did not think the difference of 1.6 cents per yard worth consideration. Freight to Minneapolis on the brick amounted to about 39 cents per square yard out of the 87.1 cents mentioned.

The amusing part of this, the first municipal attempt in the paving line, is that the dear public is pleased, and no kicks were registered but from disappointed contractors.

F. W. CAPPELEN,
City Engineer, Minneapolis, Minn.

THE PRESIDENT: The next paper is entitled: "Results of One Year's Work with a Chemical Laboratory for Testing Asphalts."

"RESULTS OF ONE YEAR'S WORK WITH A CHEMICAL LABORATORY FOR TESTING ASPHALTS."

BY GEO. W. TILLSON, CITY ENGINEER, BROOKLYN, NEW YORK.

In the spring of 1895 there were fifteen miles of asphalt pavement in the city of Brooklyn. During that season about ten miles more were laid. In 1896 so great was the interest for still more asphalt, that the Department of City Works deemed it advisable to establish a chemical laboratory for the purpose of testing in all its forms the asphalt and all other materials that go to make up an asphalt pavement. Accordingly, in April the Bord of Aldermen authorized the Commissioner to install such a laboratory at a cost not to exceed $1,000.

A chemist was at once appointed and the work begun. Members of the department were sent to each asphalt plant in the city, and exact records were made of the proportions used in the different mixtures, as well as temperatures. Samples of all ingredients were taken for the chemist: the material was followed on the street, and the exact location of each of the mixtures noted for future reference. The samples were turned into the laboratory, where they were analyzed separately, and after having been mixed, so that any difference between the actual and theoretical results could be discovered as well as any variations from the theoretical specifications, the idea at first being not so much to direct the contractor as to find out what he was doing, and, by observation in the future, ascertain the results of these mixtures.

Bitumen being such an evasive substance, and one upon the determination of which chemists differ so greatly as to method, it was decided arbitrarily to call all matter in the asphalt or pavement soluble in carbon bi-sulphide, bitumen. This would, of course, include a certain portion of the residuum oil when that was used as a flux. The specifications provided that 9 per cent. of the completed pavement should be soluble in carbon bi-sulphide. The different analyses resulted as follows:

Cranford & Co.	Highest	9.88	per cent.
	Lowest	8.96	" "
	Average	9.33	" "
Eastern Bermudez Asphalt Paving Co.	Highest	9.86	per cent.
	Lowest	8.91	" "
	Average	9.36	" "
Brooklyn Alcatraz Asphalt Co.	Highest	10.13	per cent.
	Lowest	8.91	" "
	Average	9.71	" "
Fruin-Bambrick Construction Co.	Average	8.48	per cent.

The specifications further provide that no great amount of matter shall be volatile at a temperature of 250 degrees F. Analysis of samples of Calfornia maltha showed the matter volatile

at 212 degrees F. 0.00 per cent.
at 250 degrees F. in 5 hours 0.77 " "
at 325 degrees F. in 7 hours 1.70 " "
at 400 degrees F. in 7 hours 7.62 " "

while Pennsylvania residuum oil showed
at 325 degrees F. in 7 hours 0.51 per cent.
at 400 degrees F. in 7 hours 2.44 " "

Tests were also made to determine the fineness of the sands used by the different contractors, and also of the pulverized limestone.

During the winter analyses were made of a number of pavements of different ages to ascertain how they compared with those being laid at present. The following table shows the result, as well as other conditions that must be considered in comparing different pavements:

Per cent. of Bitumen.	Kind of Asphalt.	When Laid.	Condition.	Foundation.	Per cent. of Grade.	Traffic.
9.47	Trinidad	1888	Good but wavy	Old Tar pavement on cobble	1.5	Heavy
7.48	"	1888	Good but bunchy	Cobble	1.2	Light
7.25	"	1888	Uneven and wavy.	"	1.0	Moderate
8.06	Kentucky Rock.	1898	Fair but pitted.	"	0.9	Light
9.30	Trinidad	1889	Good	"	1.3	"
7.59	Kentucky Rock	1889	Fair	"	1.0	"
7.70	Trinidad	1889	Surface good Cracks	"	3.0	"
8.48	"	1889	Badly cracked	"	1.1	Very light
9.71	"	1891	Good	Concrete	0.8	Moderate
8.95	"	1892	First class	Cobble	3.3	Light
9.81	"	1893	Good, somewhat wavy	"	3.2	Moderate

This table is given for what it is worth, but it contains all the information about these pavements that can be obtained at the present time. They were all laid by the same contractor, and it is presumed that those laid in the same year were approximately of the same mixture. It will be seen that, as a rule, the newest pavements show the most bitumen, and that those on the steep grades were in the best condition. As the facts are too meagre to make an extended analysis of any particular value, none will be attempted.

In February of this year, samples of pavement, taken from the street, made of the three different kinds of asphalt in use, were immersed in distilled water for the purpose of testing the claims of the different contractors that their material was not as badly affected by the action of water as that of the others. At the end of six months, Sample No. 1 had become oxydized, considerably swollen, soft and punky. Sample No. 2 about the same in character, but less in degree. Sample No. 3, very slightly oxydized.

In water containing a 20 per cent. solution of salt there was no apparent change. This last result was somewhat surprising, as the contractors complain that salt water running from the freezers, as ice cream is being loaded into wagons at the factories, destroys the pavement in a very short time. It is possible, however, that the alternating action of the salt water and the air might have a more deleterious effect than the former alone: or that if the pavement treated with salt water in the laboratory could be subjected to the same action it would have received on the street, it might have failed there, also. As this experiment has not been fully carried out, it has been deemed best not to disclose, at present, the individuality of the different samples.

The work of the present season has been to carry on the analysis of the samples from every street paved as detailed above, and also to make investigations as to the value of chemical analysis for practical results.

There are many problems that present themselves to the chemist for solution.

1st. Is it possible by an analysis to determine if different asphalts chemically the same will all make good pavements. Experience up to the present time would seem to answer no. When the asphalt for the Eighth avenue pavement in New York was submitted, it was examined by chemists and pronounced good, and yet the pavement made from this same material was a signal failure. But there is no record of how the mixture was made, in what proportions, or at what temperature, so that a condemnation of the analysis must not be made on the ground of the failure of the pavement. Many a loaf of cake made of good material has been spoiled in the baking. But it is a fact that chemists are divided as to the exact composition of bitumen. It has generally been considered to be made up of petrolene and asphaltene, but it is seldom that different chemists will agree as to the exact formulae for these two substances. And during the past season a new chemist has come forward and says that the bitumen found in Trinidad asphalt, instead of being made up of approximately 70 per cent. petrolene and 30 per cent. asphaltene. actually contains these substances in reverse proportions. The petrolene is the solvent and the asphaltene the hard material, and their relative propotions are important and valuable in any bitumen.

2d. Is it possible to discover by an analysis of a pavement that has been laid for some years, whether the action of the elements has changed the actual amount of bitumen originally in the mixture, or have the relative proportions simply of the petrolene and asphaltene been changed without any loss of bitumen?

It is generally considered that a pavement once properly mixed and laid will remain in good condition as long as it maintains its true proportion of petrolene, and, conversely, that it will crack and disintegrate when a large proportion of the petrolene becomes oxydized and thus changed into asphaltene. Just how much of this is theoretical and how much practical can only be determined by careful study and observation. carried on over an extended period of time. It is the general practice at present to lay a pavement soft, that is, containing a large amount of petrolene so as to ensure as long a life as possible, even at the expense of considerable inconvenience at first. If the above problem were successfully solved, it might be possible to discover a method of retarding this oxydation, thereby allowing the contractor to lay a pavement that will preserve approximately a uniform degree of hardness until it is worn out by traffic, and by so doing, materially add to the duration of the pavement.

3d. Can it be determined, chemically, when an asphalt has burned so as to be valueless for paving, and at what temperature will it become so?

One of the most difficult things to do in the operation of an asphalt plant is to keep the sand at an equable temperature. The resulting mixture of the whole mass might be all right, and still some portions be excessively hot. This overheated sand will come into contact with a certain quantity of the asphaltic cement and destroy its efficiency. A paving mixture will often come upon the street obviously wrong, but in just what particular it is often difficult to tell. In a poorly regulated plant the trouble is often caused by burning, and doubtless many times attributed to improper material. When the fault has once been located, the proper remedy can be applied.

The above questions give a general idea of what confronts the chemist when he attempts to investigate asphalt scientifically, with a view of obtaining practical results, and also shows upon what general lines our modest little laboratory is working, on the fourth floor of the Municipal Building, in Brooklyn. Any engineer or chemist who can satisfactorily answer these questions can rest assured that he possesses more knowledge on the subject than the great majority of his confreres.

This laboratory, briefly, then, has ascertained the character of all the pavements laid since it has been in operation. It knows the proportions in which the ingredients have been mixed, and the chemical composition of the ingredients themselves. It has sought to gain information, rather than to impart it, to store up facts for future deductions.

It has also started upon a system of investigation which, it is hoped, will in the future permit the chemist to be the instructor, and to lay down rules, when necessary, for the ignorant and incompetent contractor to carry out.

It has been in existence eighteen months, and has cost thirty-five hundred dollars.

The next question that naturally arises is, Does it pay? We think so, unquestionably.

When asphalt pavements were first laid in this country they were experimental. Such pavements had never been laid anywhere. Their projectors, however, had such faith in their ultimate success that they were willing to guarantee them for a period of five years. Without this guarantee no municipality would adopt a material for any use, however good it might seem at first, if there was no knowledge of its durability. Being experimental, the pioneer companies kept exact and careful records of every fact that might have a bearing upon the life of the pavement. The analysis of every article that entered into its composition, the proportions used, temperatures at which it was mixed and laid, character of the soil, kind of foundation, grade of the street, nature and amount of traffic, the climate it must withstand, and everything that might assist them, in the future, in making their deductions, whether their efforts were crowned with success or failure. In a few years a large amount of valuable information was collected. But it was, and is, available only to the collectors. It is part of their stock in trade, of their trade secrets, and they cannot be expected to give the results of their conclusions to the general public.

Through some such experience as above must municipal corporations go unless they are satisfied to leave all exact knowledge of asphalt pavement in the hands of the paving companies. This course is not professional for the Engineers; it is not businesslike for the municipalities. There is no more reason why a few people should control, through their superior knowledge, the laying of asphalt from Trinidad and other sources of supply, than that a similar number should control all the rubber that comes from Para for the manufacture of bicycle tires.

It is pretty difficult, however, to measure the value of any inspection in dollars and cents. When a building is erected, an architect is paid a certain percentage for inspection. When a bridge is built, an inspector is sent to the mills to see the different members made. If he discovers a weak piece, we say he has saved his salary. But if he discover nothing bad, if every beam tested should come up to the standard, should we say his services were useless? Not by any means. The very fact that the inspector is at the shops, ever vigilant, ready to discover any defect of workmanship or material, puts the manufacturers on their mettle and makes them careful of all their work. The moral effect of intelligent inspection can never be calculated. So, with regard to the Brooklyn pavements, while there may have been very few changes made as the direct result of this laboratory, while perhaps not a street may be very different on account of any of its analyses, I do claim that I am justified in saying that its services have been as invaluable as they have been incalculable. Between the time it began operations and the latter part of this year, the city of Brooklyn will have expended over $400,000 for asphalt alone (not including the base). Does it seem extravagant or unreasonable, then, to pay one per cent. of this sum to ascertain how this work has been done?

The time should come, and I trust it will, ere long, when it will be as easy to learn how to lay an asphalt pavement as it is to lay one of granite or brick.

It seems eminently fitting that the first laboratory of this kind should have been installed by the city of Washington, the original habitat of asphalt pavements, and the city that is watched over and cherished by the General Government. This institution did pioneer and valiant work. It established standards of material for contractors, and its dictum was never questioned. It assumed to know as much, or more, than the contractors, and the results have proved the assumptions to have been correct. It did not hesitate to condemn an entire cargo of asphalt. It won the respect and confidence of the contractors by doing and being right.

Brooklyn is now following along in the same path, a long distance behind, 'tis true, but moving steadily forward with a gradually increasing momentum. Occasionally she looks over her shoulder to see some sister city coming up behind, to whom she can extend a helping hand, so that the two may travel on together. Thus far she has been disappointed. but she will move steadily forward, alone if she must, but always ready to render assistance to any one who may call upon her for it.

Mr. Tillson: The two pieces of Kentucky Rock Asphalt I referred to were laid as samples; by whom I do not know just now, but all the Trinidad pavements were laid by the same contractor.

The President: The next paper is that of "Asphalt Pavements," by Andrew Rosewater, of Omaha, Nebraska.

Mr. Andrew Rosewater, Omaha: Mr. President and Gentlemen—A few weeks ago I received a letter from Mr. Thompson, of your association, asking if I would consent to write an article on the subject of how to avoid cracking in asphalt pavements. I was indiscreet enough at the time to promise to write a general article on asphalt pavements. Unfortunately, in assuming the duties that I have assumed this year, that of both the Board of Public Works and the Engineer of the city, I have been so crowded, and in view of the increased work, owing to the low prices obtained by high competition, we have had such an extraordinary demand for work both in sewerage and in general construction, that I found it impossible, despite all my efforts, both Sundays and evenings, to find a moment's time before starting on my trip to write an article.

In view of this, I feel that I owe you an apology for not complying with your request, but am willing, if it be your wish to indulge in a general verbal outline of the subject of asphalt pavements, giving you perhaps a brief experience of other cities, and the experience of Omaha, which has been one of the pioneers in this list, having begun in 1882 and been ahead, at one time, even of Buffalo, ranking second, and finally third in its area of asphalt pavements in the United States. This history is so connected with the battles through the courts, battles of specifications and battles of every nature that have been instrumental in bringing about changes in other cities, that perhaps a recital may be of interest to you though not in condensed form to enable you to memorize the facts and get the advantage that a proper consideration of the subject in writing would offer. The first asphalt pavement laid—or rather the first use of asphalt as a paving material was in 1849—about the time of the gold discoveries in California. It was a discovery—or an application rather—by an engineer in Switzerland of asphalt as a binding material in compressing McAdam pavements, and it became quite successful. Seventeen years afterwards this road was still in very good condition and is referred to in an historical review by Leon Malo, the celebrated European expert on asphalts. In 1854 the application of asphalt to pavements (smooth pavements) was made in the city of Paris, and it is remarkable that the first application of asphalt to asphalt paving should have been made in almost the identical proportions as is prevalent to-day. It was only two and one-half inches in thickness, with a concrete base of six inches. Shortly afterward asphalt pavements began to increase, owing to the success of this one in Paris, and in 1870 the people of London began to lay asphalt pavements. The asphalt pavements in Europe then and since, have been made from bituminous limestone, rather than from the Trinidad material. In other words, the Trinidad limestone was crushed and powdered, and then, after being subjected to a heating process, was tamped directly upon the surface and shaped to the proper form of the crown of the street.

In looking over statistics presented by Colonel Haywood, the engineer of London, upon that subject, I noticed that quite a number of these pavements laid between 1870 and 1877 on streets of extraordinary high traffic, retained their condition without any repairs for a period of from eight months to two or three years. This was extraordinary, considering that the traffic was extraordinary. It is extraordinary, because the traffic on these streets, which ranged from fifteen feet in width to twenty-one feet, averaged from 4,000 to 13,500 vehicles in twelve hours on each street. If you search the records of this country, you will find very few streets upon which asphalt pavements have been successful, without repairs, or successful at all, which approximate such extraordinary traffic. There were, of course, a great many of these pavements which were failures, or required constant repairs. The success of this particular kind of asphalt pavement on the high traffic streets in London and Paris may be instructive to us. They are distinguishable from pavements in the United States from the fact that ours are an artificial sandstone, and theirs an artificial limestone. An artificial sandstone cannot be compacted in the same manner as an artificial limestone, the latter material being of much finer grain, and when thoroughly compacted by hand is very smooth and slippery, and that is the one objection to European asphalt pavements.

In 1885 I met Mr. A. L. Barber, the enterprising manager and founder of the Barber Asphalt Paving Company. He informed me that he was about to undertake an enterprise in Europe—he had arranged to send a gang of men abroad, to teach, as he said, "the frog eaters how to lay asphalt." Leon Malo describes, in his work upon asphalt, how this enterprise was brought about, and what the result was.

The pavement was laid on a prominent avenue. A few days after its completion, it began to disintegrate, and in less than seven months the remnants were ordered cleared from the streets. Similar efforts were made in Berlin and in London, all meeting with like failures. I refer to this at the outset, while I think of it, because it has been sought to be impressed upon the public in this country, that only the asphalt from the celebrated lake on Trinidad Island is fit for paving purposes. I have for some years maintained, from observation, that nearly all asphalts could produce good pavements, providing that the formula relatively applicable to the particular locality where laid was made right, and the workmanship was sufficiently skillful to meet the requirements of the occasion.

Let us now briefly review the history of asphalt pavements in the United States. In 1870 Prof. De Smedt took out a patent for an asphalt mastic pavement made of an asphalt from the Island of Trinidad mixed with a certain percentage of sand and limestone dust, and combined, by proper fluxing, with petroleum residuum. As Mr. Tillson has stated this evening, the asphalt inspectors in the city of Washington have generally been able to dictate to the contractors how to lay asphalt. This is not surprising when it is borne in mind that Prof. De Smedt was the first inspector employed by the United States government to inspect asphalt pavements, the formula for which he himself had originated. At that time there was practically no other asphalt pavement in the United States, and it was, I believe, in 1872, that the first application of asphalt—that kind of asphalt—to streets in the United States, viz., on Pennsylvania avenue, was made. It was successful. It was nearly ten years from that time before the public, generally, in this country recognized the merits of the discovery, and there were but very few pavements laid in the United States up to the period of 1882. I think there were, perhaps, not more than half a dozen streets in the United States—one section of a street in Boston, a section of a street in Philadelphia, and, I think, there was a little piece, possibly, in Brooklyn. I don't recollect of any other at this moment. I had occasion in the winter of 1881 to visit the leading cities of the United States at the instance of the Mayor and City Council, in company with the Chairman of the Board of Public Works of Omaha, to examine all classes of pavements and make a report upon the most desirable pavement applicable to that city. Omaha was then a city of about 35,000 inhabitants, and had no pavements; had just begun to ascertain the fact that she was way behind the times for a city of that size. The result of our investigation was a report recommending stone, macadam, and asphalt, as the only materials to be used. We commenced our first pavement in 1882, and in 1885 we had a large area in the central part of the city paved. Buffalo commenced its pavements about the same time. It may be interesting, in referring to this, to call your attention to the peculiar phraseology of the specifications used in 1881. It was a specification used by A. L. Barber, for the first contract made in Omaha was not made with the Barber Asphalt Paving Company, but with A. L. Barber personally. In this specification, after referring to the proportions of the material, which are similar, practically to ours, he says, "The Trinidad asphaltum, so-called, whether crude or refined, as found in the market, contains from 20 to 35% of impurities; the asphaltum herein specified is to be specially refined and brought to a uniform standard of purity and gravity." Then, going into the general features, the proportions are fixed: asphaltum cement 15 to 18%, sand from 60 to 75% (there, however, was actually used 75 to 80% of sand) and pulverized carbonate of lime 15 to 17%. I refer to this specification, because, in our subsequent experience with this company with the asphalt, a change came over the dreams of the original contractors. Commercial interests interfered with their complete control of asphaltic materials in the United States, and in 1888 competitors began to get asphalt from the island of Trinidad to the United States, and silently, no one knows how, no one knows by whom, the specifications were suddenly discovered to have been changed from the words "Trinidad asphalt" to "Trinidad Lake asphaltum." I believe you, perhaps most of you, have read the history of the occasion of this change disclosed by the United States Consul, who made a special investigation for that purpose. I had occasion to investigate the first pavement that was laid in Omaha. It was very carefully laid upon what is known as Douglas street. It was such an excellent pavement, that eleven years afterwards a section of it was cut up and taken to the World's Fair, to be exhibited as a sample of magnificent asphalt pavement. From investigations since that time, in view of events that have occurred, which I will soon explain, I found that this asphalt was Trinidad land asphalt, or overflow asphalt, that was first used in Omaha.

In 1892, after a voluntary retirement of five years, I was called upon to resume the position of City Engineer, and I found that the specifications provided that asphalt from the lake on the Island of Trinidad only should be used, with the explanatory statement that the lake was "owned by the British Government," but it omitted to state and "leased by the Barber Asphalt Company—or the Trinidad Asphalt Company, which is the same thing—for a period of fifty years," so that they had absolute control of it. The price of asphalt in 1882, in Omaha, was $2.98, the asphalt to be 2½ inches thick, laid upon 6 inches of concrete. In 1892, ten years later, when stone, which had been $4.30 in 1882, had dropped down to $2.40, or nearly one-half, when cement had dropped thirty per cent., when sand had dropped down, when stone quarries had been developed in every direction, we still had a $2.98 price upon asphalt. I worked with the Board of Public Works for some time, and finally succeeded—how I do not remember now—it seems remarkable by subsequent events—in getting them to endorse a change by striking out the words "Lake Asphalt" and using the word "asphalt." and thus open up the specifications to the use of any asphalt based upon a proper maintenance guarantee. This led to considerable of a war. Every effort was made to defeat it. It finally culminated in bids from a Chicago company lowering the price about 20 per cent., and we congratulated ourselves upon the success of our first effort. To make this victory permanent, I wrote to authorities in Denver, to Captain Fiebeger of Washington, and to authorities in other cities, urging upon them to take the same course, as a matter of common public interest. It wasn't long before the company that took this contract formed an alliance with the Barber company and a local patron of that company, whereby, according to the testimony given in a case in New Jersey, the owners of each of the three plants in the city of Omaha were to have a fair and equal share of all work, and to maintain a uniform price, a party from the outside of the city to fix the price for each bid. Our experience verified this testimony, for the prices were substantially the same, that is, the lowest bids were about the same, the highest were materially different, so that apparently we had competition, when in fact we had none. Then followed an effort to get the owners of the California asphaltum to bid in Omaha.

Now, I hope, if I am tiresome, if I do not confine myself to matters of interest in this connection, you will let me know, as I do not want to speak at too great length. (Cries of "Go on, go on!")

In 1894 we got a bid from an Omaha contractor, backed up by a California asphalt company, which made the first break of any consequence—$2.07 on repavements, which required 4½ inches additional concrete and two and a half inches asphaltum with a five years' maintenance guarantee—and this brings me to a little interesting episode. The Board of Public Works sat at a table about like this and received the bids. When this bid was opened and read, instead of feeling gratified as you would suppose public officials ought to be, having broken the record, they seemed displeased, and adjourned to a private room with the higher bidder. A few minutes later the higher bidder came into my office and said: "Rosewater, I know you as a fighter; if you will only do me a favor by keeping your hands off, I will get that contract." I told him that under other circumstances I might accommodate him, but under the existing circumstances I not only would not keep my hands off, but would fight in the interest of the city for the lowest bidder.

After a legal battle of injunctions and extended contests between the Mayor, City Council, and Board of Public Works, in which every trick known to the political prestidigitator was resorted to, the Board of Public Works was mandamused by the Court to award and enter into contract with the lowest bidder. It is of interest to note that the claims made by the Board of Public Works in their contest, or rather the claims prepared for them by the attorneys of the Trinidad Lake interests, were that land or overflow asphalt and California asphalts were worthless as paving materials, and therefore the Board contended that it was only willing to admit into the field in competition the Bermudez or Venezuela asphalt products and those from the lake on the Island of Trinidad. The local Manager of the Barber Company testified that only recently Land asphalt in Peoria, Illinois, had proven a failure. It is worthy of note, and a remarkable illustration of the flexibility of human judgment, that a year after the contested district was paved with California asphalt the former Chairman of the Board of Public Works, who so strenuously opposed considering California asphalt, testified in a suit at Denver, Colorado, that the California asphalt pavement was as good as any in the city.

Desirous of ascertaining the facts as to the alleged failure of Trinidad land asphalt in Peoria, I corresponded with the City Engineer and was informed that the pavement was apparently all right, but the chemist to whom a sample piece of the asphalt had been submitted had certified it as unfit for a first-class pavement. Less than a year later I was called to Peoria by the contractors who laid the pavement, and made a personal examination. The pavement had been subjected to a summer and winter wear and exposure. It was one and one-quarter miles in length and was as fine a piece of asphalt paving as I had seen anywhere. There was not a flaw or crack in it from one end to the other. I examined the other completed asphalt pavements in Peoria, all of which were laid with Lake asphalt. They were literally all cracked to pieces. I paced each street and found an average of nearly one crack to every fifteen feet in length, there being over five hundred cracks and patches in all, to all of which I testified in detail in the Courts, and no attempt was made to contradict these facts. I asked the Mayor how it was that he could accept these streets and refuse to pay for one that was so much superior. He replied, saying: "There is nothing the matter with the pavement, the fact is the contractors haven't treated us right." The evidence at the trial of this case was interesting in showing how, by adroit suppression of facts, the testimony of expert chemists can be used to so befog the vision as to hide the truth completely from view. A prominent asphalt chemist was on the stand exhibiting samples of crude land asphaltum, showing how brittle they were, and in contrast exhibited a cake of asphalt about the size of an ordinary pancake. It was pliable and almost as elastic as rubber, and by his adroit presentation made a striking contrast with the exhibit of crude, unrefined asphalt specimens. I wrote a note and had it passed to the attorney, suggesting the question whether this fine elastic specimen was such asphalt as is used or fit for paving purposes. The reply produced as great reaction in the minds of the jury as the contrast of exhibits had done the other way. The chemist answered, No; and, following up the advantage, the attorney asked whether it was not true that what he had exhibited was from the liquid mass in the lake, and that the products from that part of the lake were only suitable as a flux, and that if mixed with the crude material after refining it would not produce a good pavement, the reluctant answer was, Yes.

One more result of this trial was the conclusive evidence produced by a series of photographs taken on the Island of Trinidad of Professor Peckham in an extensive ditch excavation, in which the head of the professor at first is even with the surface, and at each periodical interval thereafter the photographs show more and more of his body outside, until it is all outside, showing conclusively that the land asphalt rises to a level and is under the same formation and influences as the lake asphalt, the evidence being that the rate of flow decreases with the increased frictional resistance due to receding from the central point of presure. Another fact shown was that the chemical composition of all the asphalts on the Island of Trinidad are not perfectly even. Samples broken off the same piece of Lake asphalt of the size of a hand were analyzed by Miss Linton, the well-known expert, and varied from 1 to 2 per cent. in composition from each other. There can be but one conclusion, therefore, from this investigation, namely, that Trinidad asphalts, properly refined, whether from 200 or 300 feet, or within 800 feet or more from the so-called lake on the Island of Trinidad, are equally suitable for paving purposes, and to exclude the use of one or allow the exclusive use of another merely because of special ownership interest, is against public policy.

Let me relate another incident relative to this subject of competition. I was called into the city of Niagara Falls last spring in another asphalt case. In that case a similar contest arose as to competition, and the Barber representatives claimed that there was competition—competition between Bermudez asphalt and Trinidad Lake asphalt. All the leading officers of the company happened to have notice served upon them in New York, and under the State law of New York they were compelled to be there, and they did appear at Niagara Falls, and when the question was asked them by the Court, "Have you any stock in the Bermuda Asphalt Company, or the Venezuela Asphalt Company?" they declined to answer. The Court gave them twenty-four hours' time to answer, or take the consequences. After consultation these gentlemen concluded to answer, and they answered in a few words: "Yes, we own stock in the Bermuda Company." How much? "75 per cent." There is the whole thing in a nutshell. The efforts in the last three years, in connection with this, have brought about pavements all over the United States, and opened the field in Philadelphia, in Brooklyn, Washington, Louisville, Omaha, Denver and Salt Lake City, and, I think, Peoria and a few other cities still have a sort of quarantine established, but that does not matter; the fact is established from a commercial standpoint, and we are here to represent cities from the broad standpoint of public interest. We cannot open the gateway too wide with proper reservation—with reservation for proper guarantee. The opponents to this state that you will get bad asphalt and that there will be combines all the same. Let us see—"The proof of the pudding is in the eating thereof." Omaha has just received the lowest bids in the country for asphalt pavement and repaving. We have had bids ranging from $1.45 down to $1.22 per square yard, and with a five year guarantee. Part of the contract is for California asphalt, and part for Trinidad Lake asphalt. We have, in the repaving, adopted various specifications. One specification calls for six and one-half inches of broken stone, inclusive of an inch and a half bituminous base, and two inches of asphalt on top of that. That is, three inches and a half of asphaltic mixture and six inches and a half of broken stone and slag, with five years' guarantee, at $1.45 on the main traffic street of the city.

A MEMBER: Did you use broken stone or concrete?

MR. ROSEWATER: Concrete. In this case we have bids where concrete was laid, and on the other streets we took bids for various classifications. If I had had time to prepare a written article I should have confined myself to the engineering features of asphalt, but I consider this a representative body of municipal officers, who are interested in the commercial aspect which touches the pockets of the people, and when we talk about assessments, taxation, etc., it is certainly very important to get materials at the lowest possible price, to get competition. I want to impress you with one feature of this question, the very opening for that competition for different materials brings about certain results—it brings about competition among able men in the study of formulae for the purpose of competing with each other; each one wants to maintain his pavement at the lowest possible cost, and each one has to adopt the best way to do it, and no better incentive could be had. We did more than this—we advertised simultaneously for bids on asphalt—for bids on brick and other material, so that if the asphalt man doesn't get down low enough we can select brick or any other material. The city property owners select the material.

Now, coming to the other question, I think I have touched upon that sufficiently to explain the situation with reference to the importance of opening up of competition. I will mention, before I proceed further, one little element of jugglery that some of you may learn if you have anything to do with asphalt pavements, in the matter of controlling competition in cities, that is, an effort on the part of the first company to compel the next party who comes in to do work under disadvantages by certain special official orders, and thereby make his work a failure and exclude him from the field. One Chicago company came into Omaha, and the Board of Public Works, though antagonistic to it, dared not show it, and kept their order from being issued to proceed with the work until the winter time—until the middle of December, when it was very cold. Mr. Schubert had charge of this work—he was the man who had undertaken and failed in Europe for the Barber Company. He came to my office and said: "I can't do this work; it is going to be a failure; what am I going to do?" I was then engineer, and I said, "Don't do it." He said, "The Board ordered me to do it," and I said, "Don't touch that work." The next week the City Council issued an order—passed a resolution ordering these parties to proceed with the work. He came to me again and said, "What shall I do?" Says I, "Don't touch that work." They wanted an explanation from me about why I had taken that action. I said, "Gentlemen, if you will carefully read the specifications, they provide that no work shall be done when the temperature is below forty degrees, and, of course, I stand upon the specifications." The result was that he didn't begin that work in the winter, but he did in the spring and made a success of it. Another trick of the trade is: a competitor has secured a contract to lay an asphalt pavement, and to prejudice the public they hire teams with extremely heavy loads—teams loaded with ice—and have them stand on the fresh pavement in the heat of the day until the wheels sink down to the base. Perhaps they will pay an extra five dollars to the driver of the team to give it a twist, and he will give the wagon a side twist and leave a very unsightly place in the pavement. These are practical illustrations. They are pictures of practices that are calculated to prejudice and deceive the people. You must, therefore, investigate before you can decide to condemn a pavement simply upon hearsay.

In reference to the best method to construct asphalt pavements—what kind of grades are most suitable for asphalt pavements, and what are forbidden grades, under what conditions to proceed with the work, and what to avoid—I have this to say. I had observed, when I was in Peoria, I believe the year after the suit I referred to, that another pavement was laid with Trinidad Lake on Jefferson avenue, parallel to Perry street. This Jefferson avenue had been laid with Trinidad Lake asphalt and compared very favorably with the Trinidad Land asphalt on Perry street close by. The Lake asphalt that had been laid heretofore was upon the high uplands; they were all literally cracked to pieces. The ground upon which the lower pavements were laid was gravel and sand; the ground upon which the upper pavements were laid was clay. I noticed, in visiting Denver, comparatively few cracks appeared on pavements laid on gravel or sand base, whilst in Omaha pavements laid on our clay base cracked in a few years when exposed to extreme temperatures. In studying over the subject I incidentally read a discussion that took place in the British Association in the early part of the 'eighties.

I noticed that the subject for clay bases for pavements was specially dwelt upon, and the conclusion was reached that clay bases were the poorest kind of bases for any kind of pavement. In studying over the subject I concluded that in clay and other soils which retain moisture, freezing would tend to cause upheaval. Something should be done to prevent and minimize the tendency to create cracks by draining the clay, so that in drawing up specifications for this year I provided that on repaving work, where a concrete base exists, to cut a section through the concrete adjoining the curb, nine inches wide, and break it up in small pieces, and use the broken material for filling up to and adjoining the curb. With this broken material on each side to the depth a little below the concrete base, thus affording an outlet for any moisture that might be held, or allow such as would get in between the rails or back of the curb a way to get down to this trench, and this trench is connected by perforated holes in the castings of the inlets, so that the water can drip through and make its escape into the sewers. I further concluded that on streets which were established—I had made an examination of all our old specifications and of some work that had been done under Mr. Tillson when he was engineer—during the years 1887 and 1892, and there were a number of streets upon a base of three inches of broken stone and an inch and a half of binder, and an inch and a half of asphalt, and there are four or five miles, perhaps more, of that kind of pavement in the city. I examined them and found that they compared favorably with other streets that had concrete, and I concluded that, so far as broken base is concerned, if the ground is ordinarily sloped there is an advantage, because you would have sub-drainage under the bituminous composition on the top, and at the same time with any slight defect that exists you would have a cheap and permanent pavement. In view of that I provided that the pavement which is now being rebuilt on the main street of the city be laid with six inches and a half of broken stone, and two inches of binder and two inches and a half of asphalt on that, with provisions for sub-drainage. I don't pretend to say that an asphalt pavement with those precautions will be free from cracking, because the making of the asphalt pavement depends on a thousand and one things independent of the base. It depends, for instance, upon the character of the sand that is used, for, bear in mind, what is the sand that enters into the bituminous sandstone? It is the wearing material of the pavement; it is the material that must take all the work of the asphalt; the bitumen only acts as a binder or as a mastic, and so it depends on the sand. It depends upon filling up these voids or upon not filling them up. Upon that I am not ready to express an opinion, for experts do not seem to agree whether it is best to fill these spaces or voids entirely or not, because it is alleged by some, if filled up entirely with bitumen, it will float; on the other hand, if a certain portion of the space in the interstices of the sand is left void it will admit of a greater margin for the expansion and contraction—it will be a moderator. In a similar way the use of broken stone and slag in asphalt pavement will reduce the tendency to crack, for it will act just exactly as the fly-wheel of an engine. If there are six or eight or ten inches of broken stone material on top of the concrete base, there will be about 50 per cent. of voids under that base filled with air, and these voids of air will act as a reservoir, being warmed from the influences below, and tending to check the sudden effect of a short period of extreme weather, and thereby moderating the temperature effect upon the asphalt itself. In addition to this, the broken stone will prevent cracking of asphalt caused by the motion of the concrete in contraction or expansion. There are other influences, and, perhaps, some that are seldom thought of. I have observed that the effect upon an asphalt pavement laid in a very strong wind in the summer time will be more chilling than the effect of cold, still air in the winter time, for the simple reason that the asphalt mixture necessarily must have 250 to 300 degrees temperature when laid, and with a great blast of air at 70 degrees the absorption of that heat will be much more rapid and greater than exposure to still air at a much colder temperature. That is my conclusion from observation, and I think it can be borne out by mathematical demonstration.

The question of how much and the character of the powdered stone that is put in has an important bearing. What is the powdered stone put in there for? It may be put in as a filler, to avoid putting in a certain amount of bitumen in excess of what experience has demonstrated is necessary. It may be put in as an absorbent of a certain amount of oil used as a fluxing material to hold it there as a check on the effects of frost—or for these and other purposes combined.

I have not yet seen an expert who could explain to me all the bearings and all the factors that this is intended to subserve. I have thus shown some of the influences of the various ingredients of an asphalt pavement. The chemist may sit in his laboratory and determine the proper proportions of these ingredients. Are we certain his formula will be carried out? Let us go into the workshop, where the asphalt is being mixed, and what do we find? Unless you have a half dozen men watching another half dozen men—and they will get careless—they will put the asphalt in the mixing pot and by waiting and leaving perhaps a few inches' thickness each time adhering to the sides, no two batches will be exactly alike, resulting in a more or less unfavorable mixture, even though the machinery is perfect and the chemists' formula correct.

There are countless details. There is the sand—suppose it was wet and contained a certain amount of moisture and was not properly dried—then the limestone, which should be pure—it may be mixed with clay, more or less. The chemist picks up a little piece, half as big as your hand, an infinitesimally small particle compared with the whole pavement, and after an analysis of this little piece tells you, "that is going to make a bad pavement." As Mr. Tillson stated in his article this evening, they predicted in New York that a certain pavement would not be good. It was good. They predicted in Peoria that a certain pavement would be bad, and would be a failure, and it was a success. They predicted that the California asphalt was unfit for pavements, but it was excellent. The same was said of the Venezuela asphalt, and when the Venezuela asphalt made its successful debut, the Barber Asphalt Company absorbed the controlling interest in it.

Having disposed of numerous fallacies and misconceptions as to asphalt, we come to the other proposition, how to lay the asphalt when all the mixtures are properly made. Suppose the concrete base is moist—suppose there is a little chilling weather in the morning, that is, just enough to have precipitated a dense moisture in the atmosphere—it leaves just a slight film, you can hardly observe it on your coat, but you proceed, as it gets a little warmer, to lay your asphalt—you have a certain amount of moisture beneath that raises steam and causes lumps. Thus such conditions will necessarily develop and they clearly show that it requires experts in every branch of the work, and at every point.

Now we come to the question of the grades and crowns of streets. I have made a special study of the subject of crowns, and it was my opinion until within a few years that an asphalt pavement ought to be very flat. As a matter of fact, after observation, I have come to the conclusion that it ought to have more crown than brick or stone pavements. I concluded from observation that it was not only better, more pleasing to the eye, but it was safe, and effected a most rapid drainage. The street should shed storm water as rapidly as possible, consistent with proper construction, into the gutter. If the grade of the street is very flat it must have frequent inlets into the sewer, or else unsightly pools will develop along the side of the street and deteriorate the pavement.

On the question of grades, until within a few years it has been supposed that a grade of two per cent. would be sufficient. I have observed pavements for eight or nine years with grades as high as eight per cent. I passed through Kansas City a few days ago and on Main street I noticed grades there that must range from seven to eight per cent. Thus, on the question of grades, it has not yet been definitely settled to what extent, beyond the limitations heretofore adopted, it is proper to go. For short distances of 400 to 500 feet a six and and one half per cent. grade has proven practicable.

Gentlemen, I am very much obliged to you for your attention, and I apologize for having taken up so much of your time. (Applause.)

THE PRESIDENT: There is another paper on asphalt street repairs, by Mr. Milner of St. Louis. Is he with us?

Mr. Milner not being present, the President continued:

THE PRESIDENT: This finishes the papers on asphalt. The question is, shall we go ahead with the other papers, or have a discussion on the asphalt pavements?

MR. THOMPSON: I move that the three papers presented be taken up, and the discussion on asphalt pavements be opened at this time. Carried.

THE PRESIDENT: Gentlemen, you are at liberty to ask such questions as you desire on any of these papers.

MR. THOMPSON: I desire to correct Mr. Rosewater in one or two of his statements. I believe, as he stated, that we should be fair to all companies, and I believe that in his statement of the condition of Lake asphalt in Peoria, he exaggerated, unintentionally. At the time he was called to Peoria—by the way—I was not City Engineer, and I don't know whether he heard from me or not, but I was simply a Civil Engineer, in charge of the paving work. At the time he was called there, there were two or three streets paved with Trinidad Lake asphalt, and they were on a clay sub-soil on the bluff, the first that had been laid in the city, and the mixture had not been determined—the proper mixture. In addition to this the concrete foundation was poor in a great many portions of it, consequently, after the second winter, the pavements were in some parts, I think, badly cracked. Last year I had occasion to inspect these pavements—about one-half these pavements—the guarantee of five years having expired, and I found all of them in good cond'tion, with the exception of two portions—two or three portions—of these streets. One of the portions was in bad condition, because the city had neglected to provide drainage, and this part had been exposed to water standing on the pavement; the boys used it for a wading pool in the summer, and a skating rink in the winter. This portion the company could not be held responsible for. The other portion was badly cracked, and it will be renewed this fall—the guarantee on that will expire this fall. That part of the contract they are responsible for, and I attribute it as due to nothing except they had been careless in the mixture. In other words, the general condition of the Trinidad Lake asphalt on the streets of Peoria is excellent. The street of which Mr. Rosewater speaks was laid with Trinidad Land asphalt, and is the best piece of workmanship I have ever seen in any section of the country. The pavement, however, is cracked in the same manner, although laid on a sound foundation. It cracked after the second winter, and there are two portions of that street which are now in a bad condition, and there are cracks through other portions of it. The two portions of it in bad condition represent about two days' work along about the beginning of the work, and one close to the end; it is as badly cracked as anything we have in the city.

Now I do not believe that it is necessary to confine your specifications to any one material on asphalt, but I do think that the city officials should be very careful in throwing the gate wide open to anything and everything. We allow the use of Trinidad Lake asphalt and Bermudez, and next year it will be thrown open to one or two other companies. As far as the Trinidad Land is concerned, I am not prepared to express an opinion as to whether it is a success or a fake; on all the streets I have examined of what they call the Trinidad Land asphalt, it has been in bad condition, with the exception of that laid in Brooklyn during the last two years, and the question arises, if what they call the Trinidad Land is what they are laying at present in that city.

Then Mr. Rosewater spoke of the sand foundation and the clay foundation. I would like to ask the gentleman if he attributes the cracks to the kind of subsoil in which it is laid, whether it is clay or sand.

Mr. Rosewater: I say that that is one of the influences that might cause cracking; I don't say that cracking of asphalt pavement is due entirely to the foundations, but I say that the foundations ought to be looked into just as much as the mixtures; they both have influence in causing cracks, and I do not confine it to any one influence.

Mr. Thompson: Mr. Rosewater, I would like to ask you if you have ever seen one case where cracks were caused by the heaving of the subsoil?

Mr. Rosewater: Yes sir, I have.

Mr. Thompson: Could you locate them?

Mr. Rosewater: Yes sir, I could locate them right in the city of Omaha, on the soil that had proper drainage.

Mr. Thompson: The only reason I asked is, because I supposed we would have to get a great deal of accommodation also.

Mr. Rosewater: In fact, I want to say, that I have had a talk with Mr. Graun, the President of the Barber Company, within six or seven weeks, and he agrees with me, that this sub-drainage had considerable influence in causing cracking in some pavements he had in Buffalo and he concurred with the specifications submitted at that time, believing, as he said, they would have a great tendency in a direction toward checking that cracking in pavements.

Mr. Thompson: I have never seen a case where there was any evidence that cracks in an asphalt pavement were caused by the upheaval of the soil upon which the foundation rested.

Mr. Benzenberg, Milwaukee, Wis.: This subject of asphalt pavements is one which is being pretty generally considered by the municipalities of this country, because of the low prices at which it seems some cities are able to obtain the laying of asphalt pavements while other cities are obliged to pay very much higher prices. If conditions are taken alike, I do not think that there is quite such a difference of prices as is apparent. In Milwaukee, we have been laying asphalt pavements at a price, depending upon the depth of the concrete and the amount of asphalt in the two coats over it, from $1.95 to $2.30, which includes—the latter price—seven inch base of concrete, and the laying of a brick gutter, consisting of Hayden block, and the lining of rail on street car tracks with granite blocks. Some two years ago, being desirous of opening the door to other companies, the Mayor of Milwaukee and myself, having heard so much about the Omaha "California asphalt" pavements, particularly from the Chicago contractors who were very anxious to obtain the right to bid in Milwaukee, visited that city about this time of the year, and it was because of the very poor, dilapidated condition of the pavements of California asphalt that we kept the doors of Milwaukee closed against that company. I never saw a poorer lot of pavements than had been laid there at that time, and the Mayor agreed with me. He said "we don't want that sort of stuff in our city, and we can better afford to pay a higher price for pavements than to have that sort of pavement laid here, and have our asphalt pavement receive a black eye." We considered that we were not after cheap pavement, as much as we were after the best pavement, and the best pavement at a higher price was cheaper in the end. To prevent cracking, it has been customary for some time, in cities where there has been a clay sub-soil, to underdrain the pavements, leading the drain to a point immediately back to the curb, where the sub-drains were continued on sand, to catch-basins at the corners. I do not remember that this has made any material difference as to the cracking of the asphalt, and it seems to me reasonable that it should not. If the asphalt is cracked because of any upheaval due to frost from beneath, the concrete first must crack, and in order to produce a crack of that kind, the concrete must be raised to some considerable extent. I have examined the cracking in Omaha, and some we had in Milwaukee, where we had nothing but clay sub-soil.

Now I cannot quite conceive that the cracking due to frost upheavals from below will appear, excepting that the entire pavement will raise and crack. I believe, however, that the cracking may be due to the contraction and expansion of the asphalt itself. I know of cases where the asphalt was cut out on either side of the crack to discover whether the concrete had been cracked beneath it. Nothing was seen, the concrete was intact, there was no crack in the concrete, although there was a crack to perhaps three-eighths of an inch in width in the asphalt. I do not think, therefore, that the sub-soil has anything particular to do with the cracking of the asphalt itself.

I do not think that the question of the asphalt material is one that should be taken into consideration so much in barring out bids, as the ability of the bidders to do the work. There is no question but what the Bermudez or the Venezuela asphalt is a purer article than the Trinidad. There is no question but what the California asphalt is a purer article and will make a good pavement if the material is properly handled. It is not so much the question of barring out material, therefore, as it is to bar out the people who are handling it, or people who propose to lay the asphalt. If the California asphalt is handled and laid by parties who have sufficient experience, who have obtained the necessary information to determine the proper formula to be used in different cities, to resist the different traffic that may come upon it, or the changes of climate that it may be exposed to, then it is all right; but it is different if you have a new firm, who happens to conclude that asphalt is very easily laid, without any apparent skill, and offers to purchase material which has not been tried at that particular place, and proposes to lay that asphalt. Although the material may be good, you have no guarantee that you are going to get a pavement that will be serviceable or will stand; therefore the parties who are attempting to lay the pavement should be asked to prove that they have sufficient experience and knowledge upon the subject or be barred out.

I am very sorry that Mr. Cappelen of Minneapolis is not present, because he has touched upon one feature of this subject that I think is open to criticism. He suggests that it might be better and wiser, in the end, to establish a municipal plant. That would be true if it did not require special expert knowledge, obtained by long years of experience, to determine what the formula of the asphalt or mastic cement should be. If it were a question merely of concrete foundation, there is sufficient knowledge or information obtainable that would enable almost anybody to put in proper concrete, but when you handle asphaltum and mix it with lime-stone dust, and then with crushed sandstone, or sand, why you have got to know something as to the proper proportions necessary to give you the best results. That such is the fact is clearly shown, when even those who have had twenty years or more of experience in compounding asphalt for street pavements, have here and there made serious mistakes—mistakes for which they could not themselves account, but evidently mistakes, because the pavements went to pieces in a short time. They erred somewhere, although it was for their own interest to exhaust the best knowledge they had in their possession to put down a good pavement.

Now I do not believe that a novice could start in and determine the proper formula for the use of asphalt pavements, and guarantee a first-class result. I think that would be one of the first and most serious troubles that would arise in the erection of a municipal plant, unless the city was fortunate enough to engage some one who had had sufficient experience with some of the older companies. I believe that is one reason why many of these new companies have failed; and is the reason the first company that put down California asphalt in Omaha failed, because they didn't have sufficient experience. There was an asphalt pavement laid down at Omaha at the time of our visit two years ago, by a contractor who had theretofore laid no asphalt pavements, but who went into experimenting, by laying a drive-way for quite a long distance through his plant, using a large number of asphalt cements compounded upon different formulas. He obtained some practical experience by running heavy travel over that pavement and watching the results; and he used the best formulas derived by this experience for the construction of the street that he had contracted for. I had the pleasure of driving over that street only three or four weeks ago, and I will say that the asphalt pavement looked remarkably well. There had apparently been a number of cracks—the indications of the closing of cracks were to be seen every fifteen or twenty feet—but, generally, the pavement was in very good condition. It was laid with California Alcatraz asphalt. I believe that this man succeeded because he made it quite a study before he undertook to lay the pavement. During the progress of the work I understand he changed the formula, for reasons which were apparent at the time, but I think that it is well, and it is wise, for those who have charge of the laying of asphalt pavements to exercise a great deal of care in preparing the specifications in such wise that no one but experienced men—men who know what they are about to do when they undertake to lay an asphalt pavement—shall be permitted to bid. I believe in open competition, as Mr. Rosewater says—open the doors wide —yet not so wide as to have the work done by inexperienced people, and have the work naturally result in a failure.

Mr. N. P. Lewis, Brooklyn, N. Y.: Brooklyn was probably one of the first cities in this country to open its doors to general competition in laying asphalt pavements. I think, also, that one of the first, if not *the* first bituminous pavement ever laid in this country was laid in Brooklyn. The same contractor who laid that pavement has been in the business in Brooklyn ever since. In 1868 this contractor laid about 2,000 feet of bituminous concrete. It was made, of course, of tar and what remained of it was last year used as a foundation for an asphalt pavement.

Now I believe that the pavements of Brooklyn, as a rule, compare very favorably with those of any other city. We have a few notable exceptions where the pavements have cracked badly. Up to four years ago, I regret to say that the pavements of Brooklyn were laid without any engineering supervision—without technical supervision of any kind. The contractors undertook to lay the pavements, and the city took what they gave them. The results, as a rule, have been astonishingly satisfactory for work done under such conditions, and, I think, they are largely attributable to the fact that the work was done by contractors who have had the most extensive experience in such work. I find that the pavements that cracked were laid, without exception, in one year.

In compiling a list of our pavements in which the material used was described as Trinidad Land, or Trinidad Lake, asphalt, or whatever it may have been, I was dependent for my information upon the testimony of the contractor as to what material he had used. It was rather remarkable in looking over the list to find that every one of those pavements which had not been satisfactory was put down as Land asphalt. I do not dispute the fact—it may be so—but the contractor has also admitted to me that in one certain year he and a number of other contractors all procured their residuum oil from one company. Every one of the pavements laid with that oil turned out badly. Of course, if a contractor used only, as a rule, Trinidad Pitch Lake it is not unnatural he should call material which turned out badly "Land Asphalt."

Now, as to competent supervision, I would rather have thoroughly experienced contractors lay any material which I have ever used than to have some novice come into the market, and lay the Trinidad Pitch Lake, or the Bermudez.

Our Alcatraz pavements, as a rule, are very satisfactory. They have been laid for the last two years by contractors whose experience had been previously confined to laying stone pavements. We have tried to promptly correct any mistakes they have made, and their work will compare favorably, I think, with our other pavements, except in the case of their first contract, where the mixture was quite hard, and the result was the only pavement in Brooklyn upon which we have had to place sand to prevent danger on account of slipperiness.

Now, as to the structural formation of the pavement, the way in which it is built up, it seems to me that there has been in the past a tendency to lay too much stress upon the use of an extra thickness of material—especially where heavy traffic was expected.

I do not believe that the diminution in the thickness at the end of five years is material. I *do* know that an excessive thickness invariably causes rolls and wrinkles.

One of our oldest pavements, which is the oldest continuous asphalt thoroughfare in Brooklyn, has been in existence 25 or 26 years. The street was first paved with tar concrete, laid on cobblestone; it has been resurfaced from time to time with asphalt. On cutting open certain sections we have found bituminous matter ten inches in thickness. Settlements over trenches have been repaired by piling on more material. This pavement it is absolutely impossible to keep smooth and in good surface on account of the excess of the bituminous material, which will wrinkle and roll.

The question suggests itself: Are we not laying our pavements thicker than necessary when we use two inches of material? If we can lay the pavement one-inch-and-a-half thick, and get thorough compression, and at the same time lay it soft enough to avoid danger of cracking, will we not avoid this unevenness of surface? I think this subject will bear investigation, and the results obtained will, I think, be more satisfactory, especially in places along railroad tracks where you want to have your pavements as dense as possible. Certainly the thinner your pavement, the more thoroughly you can compress it under a heavy roller, or by tamping.

Mr. Cappelen's paper is in some respects unsatisfactory, in that he does not tell us what his own conviction is as to the advisability of a city the size of Minneapolis, or any other city, doing its own work by day labor. He raised the question, and I supposed, intentionally, gives no answer. It is a subject for very careful consideration. I think the day will come when all large cities will do such work themselves, *but not now.*

There seems to be an opinion on the part of some engineers that the exaction of a guarantee is unprofessional. I do not think so. I do not believe that it is proper for engineers with their present knowledge of the subject to dispense entirely with the guarantee of contractors who have been studying this thing minutely, carefully, and conscientiously for years. The guarantee is the best evidence of their good faith which we have, and it is often the only means of keeping out thoroughly incompetent men. We, in Brooklyn, I think, are working towards this end, laying our own pavements. Our laboratory will certainly give us valuable information which will be extremely useful. But Civil Service Reform has not yet reached such a stage as would warrant any municipality in attempting to organize a force to do such highly expert work as the laying of asphalt pavement. There is no gentleman here to whom this statement will not appeal if he has had any experience in municipal work. The experts employed by our contractors are mostly Italians. The average municipal officer would certainly shrink from the responsibility of employing Italians on this kind of work, and I do not think the time has yet come, or that our Civil Service has been put on such a basis that we could expect to employ thoroughly competent men, no matter where we got them, even if we were to go out of the city, or out of the State, pay them fairly for their services, and retain them permanently. Then, the short tenure of office which the average City Engineer has militates against this method of doing the work. There is one place where it might be done, and that is in the city of Washington, where all the work is done under the supervision of the United States Engineer Corps, all men who hold their offices for life. They are sometimes transferred as the Methodist ministers are, but they never get away from the traditions of their department. But, even the city of Washington has never tried this experiment; they have never laid a yard of asphalt pavement except by contract, and they let contracts for the maintenance of their pavements also. They buy the paving mixture by the cubic yard, and pay the contractor for the material used in repairing, and for the work of making excavations and repairs after the term of guarantee expires. I am sure, Mr. President, that the time for the municipal operation of an asphalt paying plant has not yet come.

Mr. Stainsby, Newark: Being very desirous of securing information that would become valuable to the Board of Works of Newark—and I presume also a large number of the gentlemen sitting in this audience are exactly in the same position—I am merely a merchant—I have been asking myself while sitting listening to the gentleman from Omaha and the other gentlemen who have spoken, who have all been educated in the schools that should bring out good pavements, from which one will we get information to obtain a good asphalt pavement. Suppose we took the whole of them and set them down now in the city of Newark before our five Commissioners, who have almost unlimited power, for we don't have to have a petition or anything else; we can pick out a street a mile or two miles long and pave it; it seems to me, my friends, after the years of experience and time there has been spent on asphalt pavements, that if we take our friend Lewis (and I consider him one of the best in the country) and then the gentleman from Omaha, who has been making enormous study in questions of asphalt, and the Trinidad Asphalt Company, and other gentlemen here, our friend from Minneapolis and others, and yet, Mr. Chairman, I have sat here this afternoon and heard from none of these gentlemen a direct opinion that will carry us out in the matter of laying asphalt pavements. To-day it is an expert business, no matter how you attempt to put it down; one says you must have such and such a per cent. of lime, and such and such a per cent. of sand, and such and such a thing maybe in one part of the country, and that material may be procured exactly right in my part of the country, and it may not in another; another gentleman says "get a plant, and do it all yourselves" and in his paper, the gentleman said the pavement cost $1.75 a yard, paying $1.75 a day for labor. Contractors in the city of Newark pay $1.00 to $1.25 for Italian and negro labor, and they are no harder pushed or driven than that labor employed for $1.75 a day, for ten hours a day. We employ labor for 17 cents an hour and nine hours in a day, that is a day's work; and yet they say "get a plant." Murder the plant. In our part of the country, where we change politics every year, it would cost the city of Newark double the price that it would without a plant, that is what it would without a plant, that is what it would cost the city of Newark, or New York, or Brooklyn, where they have got the best men, who might go out any moment. What are we to do? He says in Brooklyn they will get a plant, or at least a laboratory—is that what you call it? I want to say this: in the city of Newark we have no laboratory; we have a Board of five business men and two engineers; and I want to say I will take any three engineers in this convention here to-day to the city of Newark, and then take them over to Brooklyn, and they will give Newark the praise twenty times over. I am only talking; I am a merchant; this gentleman, Mr. Adam, is our engineer. We are going to open the door; we are going to put a ten years' guaranty in the specifications next year. I want to say this: Newark is very progressive, she is progressing faster than any other city that there is east of the Allegheneys, with her 260,000 inhabitants. A few years ago our city was in the worst condition, as regards pavements, of any city of that size, although this year we have had some little difference between the officers of the city and the Mayor, and we have done no asphalt paving. Next year we are going to do something—we are going to do a great deal. This time we brought with us four or five commissioners and the engineer of streets and sewers, and also the engineer of the Water Department. And I want to say that after hearing what the gentleman from Omaha and these other gentlemen have said, to save my life I do not know what to do. (Laughter.) I will say this, I believe this, gentlemen: that when you talk about putting in city plants they must be in the hands of experts—for I believe this about asphalt, that if the asphalt is mixed right, if you have got a man who can take care of it, I don't care where you go to get it, any of it will make a very good pavement—I don't care whether it's Lake or Land, or, in other words, it is not the material you put in it—the trouble is to get a man that knows how to mix the material. We have got altogether of Trinidad Lake asphalt in Newark 19 miles; as the gentleman here says, we have two companies—both using the same asphalt; we have got considerable asphalt and very little brick; our soil is mainly sand and very little clay in the city of Newark. We put down six inches of concrete and one and a half of binder. The binder is better at one and a half than a half inch cushion of asphalt. I want to say this: this convention, I believe, is just what the President intended it should be—one of the most important in the United States of any convention that can be got together, but it does seem to me that after all these years the engineers themselves should have some light so that the cities could prepare proper specifications. We members of Boards are practical men, I think, and we say that the engineers, with all credit to such men as Mr. Lewis and the gentleman from Omaha, and so on, that they sometimes get a little off in their results. (Laughter.) That is all there is about it. You can get good work, if you do a little brain work—you have to have brains in order to get through the world—brains will help you. Mine have been used a good many years—and I want to use them a little longer. I wish to say, gentlemen, that this afternoon has been spent in the most important subject we can get at. Asphalt has got to be put down good, or it is going to be a failure, and cities can go on and make an expensive outlay of money and have it to do over in five or ten years, and your five years soon slip away; ten years are soon gone, and the money is always gone, and then the foundation you speak about being left there—but when the contractors come along and you ask them to re-surface it, they put the cost up almost to the original figure, leaving the foundation out. I don't care whether it is made from Trinidad Lake or anywhere else, if it is made right. But how in the world are we going to know when it is right if the men who are making a special study of it differ as they seem to now?

Mr. Rundlett, St. Paul, Minn.: Mr. Chairman: The question of the cracking of pavements is one in which the St. Paul delegation is much interested. I think we have as fine asphalt streets in St. Paul as in any city represented in this convention (Newark not excepted) with the exception of the tendency to crack. It appears to be greater with us than with most cities.

The first asphalt pavement in St. Paul was laid some 11 years age on Summit avenue, our principal residential street, which has probably more light traffic than any other residential street in the city. The pavement was laid under a ten year guaranty, the contractor agreeing to keep the pavement in repair during that time and to leave it at the end of the period of ten years in as good condition as when laid, to the satisfaction of the Board of Public Works, natural wear and tear alone excepted. During the first three or four years but few cracks appeared, but after that time the number increased each spring. But few of the cracks were large or extended across the street, most of them being fine cracks crossing each other in every direction. During the summer under the heat and traffic these small cracks are mostly closed up and are hardly perceptible except after heavy rains when the street began to dry off. There were no signs of disintegration except at points where several cracks of some size came together and the water was enabled to get in. The street contained about 30,000 square yards and but few repairs were made during the ten years, but at the end of that time, when the street came to be accepted, the Board of Public Works ordered about 8,000 square yards to be replaced on account of these cracks. Otherwise the street was in very excellent condition and showed but little signs of actual wear. A few years previous specimens were cut out of the street for an exhibit at an exposition of paving material, and both concrete and asphalt made a very satisfactory showing.

The pavement was laid on a good sand foundation for nearly the whole length of the street and the grades were such as to give excellent drainage. The cracks in the asphalt were not occasioned by any cracks in the concrete, for where the asphalt was taken out a very careful examination was made and the concrete was in perfect condition. It was not due to the softness at which the material was laid, for on one of the streets laid the next year where the traffic was light more asphalt was used and the material was put in much softer, but the street cracked even worse than Summit avenue. Neither was the cracking occasioned by the use of too much water, for the asphalt in the residential district is not sprinkled. They are kept as clean by hand sweeping as the streets in any city I have ever visited.

I have attributed it to the extremes of temperature and the very dry climate we have in St. Paul, which after a time evaporates the oil and the pavement becomes more brittle and cracks. The asphalt companies have been laying asphalt pavements in St. Paul for ten years and have not yet solved the problem as to how to lay a pavement without cracking.

Something has been said about laying asphalt pavements in frosty weather. I do not believe in laying asphalt in freezing weather and would not do it under any circumstances if it was possible to avoid it, but it happens that on this very street of which I am speaking, Summit avenue, after the contractors had laid the concrete and it had properly set, some delay was occasioned in the shipment of asphalt and cold weather set in, and the contractor was actually obliged to sweep the snow from the street before laying the asphalt, and, singular to relate, that block has had the least repairs on it of any block on the whole street.

On the map Mr. Cappelen submitted with his report, showing the amount of pavement taken up on Nicollet avenue each year after it was laid, he attributes the large amount which was taken up the first year in a large measure to the fact that it was laid so late in the fall, but it appears to me that this might be attributed just as well to the burning of the asphalt or possibly the use of poor material. The Warren Scharf Asphalt Paving Company, who laid that street, the next spring paved Fourth street in St. Paul and laid as good a pavement on that street as has been laid in the city anywhere. At the present time there is hardly a crack in it and it has fewer cracks than some pavements since laid. I only mention these facts to show that in my opinion there is no infallible rule you can follow in order to get a perfect pavement. If these large paving companies who have been studying this subject for so long a time make mistakes, how is an engineer going to work it out on any mathematical theory?

To get a good pavement you must have the best of material and the best of workmanship and exercise the greatest care in every detail.

I agree with Mr. Lewis in regard to the thickness of the pavement. I do not think a very thick coat is necessary, but a great deal depends upon the compression. The asphalt should be thoroughly rolled before it gets cold. I am not therefore in favor of the city owning an asphalt paving plant. I believe rather in making the specifications strong, seeing that all the preliminary work is properly done, leaving the matter of the asphalt mixture to the contractor, and requiring a ten year guarantee with a proper surety bond.

St. Paul specifications require that 15 per cent. of the money shall be retained, on which we pay interest at six per cent.; and also a bond for the faithful fulfillment of the contract and guaranty in the full amount of the contract. By these means, I think, the contractor will be stimulated to do the best possible work. Engineers and Boards of Public Works have a great many things to attend to, not only pavements, but sewers, bridges, etc. These companies who go into the asphalt business must, as a business proposition, employ proper experts and use every means possible to get good work, knowing that they must replace the pavement if it is imperfect.

CAPT. BEACH, Washington, D. C.: Mr. Chairman, as Washington is being referred to a good many times, I would like to say a word or two as to what is being done in that city. In the first place, as to cracks, there are some streets in Washington on which the asphalt is pretty badly cracked. In no case do I think it can be referred to the action of frost or the upheaval of the ground, for the reason that that asphalt pavement is laid with a six inch concrete base. The soil throughout Washington with one or two exceptions, is a kind of gravel or sand, so that the water percolates freely through it. All cement sidewalks are laid five inches thick, without any foundation or sub-stratum for drainage, but very few of these are ever thrown up or damaged in any way by the frost. I can go back eight years or more in speaking of that, so it seems to me that when a cement sidewalk five inches thick is not thrown up by frost, you could hardly throw an asphalt pavement with two inches of binder and two inches of top and six inches of concrete.

A MEMBER: I would like to ask if you have any frost in Washington?

CAPT. BEACH: The thermometer gets down below zero.

A MEMBER: Tell us how long—does it get far below the freezing point?

CAPT. BEACH: About twelve degrees; it stays below the freezing point sometimes for over six weeks at a time. I only state that to show that the cracks are not caused by upheavals in the soil. Leakage from the gas mains and percolation gradually through the concrete will destroy the life of the asphalt. We have had to replace several streets just on account of the leaking of gas mains.

With regard to the price at which pavements have been laid, Mr. Rosewater didn't quote the lowest price. The lowest I know of was laid this summer, by the Barber Asphalt Company in Saginaw, Michigan, at $1.16.

MR. ROSEWATER: That has been brought about by competition with the rest of them, I suppose.

CAPT. BEACH: The repairs in Washington are made entirely by contract. The present contract is with the Cranford Pavement Company, and the prices are based upon the amount of material placed in the street.

A MEMBER: What is the price?

CAPT. BEACH: Seventeen dollars per cubic yard; where we use binder and asphalt surface both, $30.00 per cubic yard, where the repairs are made by the heater and burner system—this burner system is used where the street is wavy or lumpy; simply for the removal of the wearing surface—not of the binder, nor of the base, and the burners, using gasoline, are passed over to burn it down to the required depth, and the surface is scratched with rakes, to make it a little uneven so that the next coat will hold, and that is just the wearing surface—that is, the asphalt—and sand placed on top and rolled. This we have found to be much the cheaper method for repairing streets.

A MEMBER: How much does this kind of repair work cost per square yard?

CAPT. BEACH: The amount of material depends upon the depth of the hole or the depth of the repair. If we can catch hold of a break in the pavement before it has reached any depth, and use less material, it is to our advantage to do so. The price, of course, is based upon the experience of past years with regard to the work, but if we can catch a break in the pavement before we have to put in any binder, we are that much ahead.

A MEMBER: Can you give us an idea after five years how much it costs a year, taking the whole surface?

CAPT. BEACH: I am sorry to say I cannot, because the records there have not been kept as carefully as they should be on that point. On Washington streets, you see, they have used asphalt for nearly twenty-five years, and they had the old tar pavements years before. The tar pavements referred to by Mr.

Lewis in Washington streets, were laid 25 or 26 years ago, and have given excellent service. Some of them are in as good condition as the older asphalt pavements to-day, while the asphalt pavements laid in 1886, 1887 and 1888 have been practically worn out, and will soon have to be re-laid.

Mr. Rosewater referred to one or two tricks of the asphalt men, but he didn't refer to one which I have known them to use with pretty good results in driving over a brick pavement, or some other pavements where they wanted to compare it with the smoothness of an asphalt pavement. They would get a buggy and horse and let the belly-band a little bit loose and oil the fifth-wheel, and the result is the body of the vehicle plays very freely, and you get the motion of going over a very rough street, when it is only a very slight inequality.

The grades in Washington are ordinarily, for asphalt pavements, about six or seven per cent. We have some seven to eight, some nine and some ten per cent. This last is entirely too steep, and it becomes dangerous. I don't think the asphalt pavement should be laid over 7 per cent. grade.

The thickness of the wearing surface has been varied at different times. It used to be two inches; then it was lessened to one and a half inches, but we have lately gone back to two inches, for the reason that we found the wearing surface of one and a half inches didn't give as satisfactory results as two inches, so that we have gone back to two inches in our later pavements.

Mr. Adam, Newark, N. J.: We have 19½ miles of asphalt pavements, very little clay bottoms, mostly on sandy soil. In two streets only have cracks appeared; these run from curb to curb. I called the company's attention to them, and my view was that they were entirely attributable to the expansion and contraction. They called my attention to the fact that their engineer had observed this also, and that he was going to provide a remedy, that he had charged the contraction and expansion to the concrete base. I noticed, in his report last year, he advised leaving a space about an inch between the concrete, in the distance of 300 feet. From that I infer that he had taken the ground * * that it was owing more to the contraction and expansion of the concrete than to the contraction and expansion of the asphalt. Mr. Beach said they couldn't observe where any cracks had taken place in the concrete. When I read Mr. Rosewater's views as to broken stone and the clay soil, I could not well agree with him, because I don't think it is owing to the contraction and expansion of that soil. As regards the substitution of a less thickness of asphalt, as Mr. Lewis of Brooklyn says, it might be worthy of investigation.

One particular point that one of the Commissioners of Newark has spoken of, is that he didn't think he received satisfactory information at this meeting as to the best thing to be done at Newark, where they intended to open the doors for competition. Until last year all the asphalt pavements were laid by the Barber Asphalt Company, that is, Trinidad Lake. About four or five years ago there was a local company organized, which expected to be allowed to lay other kinds of asphalt. But the Board of Works and the people were not satisfied, and they were compelled to use Trinidad Lake asphalt also. This went on until within two years ago, some of the Commissioners thought it about time that the prices of asphalt pavement should be reduced and come in line with other cities where the reduction had been given. They then resorted to brick pavements. That for a certain time produced an effect, but not so much so as to bring down the price in a manner to compare with the prices in other cities in the last few years. Last year they started out to open the field to competition and to restrict the use of asphalt to four companies: the Trinidad Lake, the Bermudez, the Alcatraz, and the Imported Rock asphalt, but when the bids came in they showed that the Alcatraz and the Bermudez and the Rock asphalt kept entirely out of the field. They didn't even submit any prices, although I wrote them personal letters calling their attention to the letting of the work in Newark. At the second time the bids were opened, another company had come in, and they intended to use Land asphalt under the guise of being overflow, or a Land-Lake asphalt, but the specifications were so strict upon limiting to these four kinds of asphalt that the bid of this new Company was thrown out. They had bid $2.10 per square yard, where the others were $2.37. Either from the competition with brick pavement or from the fear of new companies starting, the price has been reduced in Newark from $2.93, which was the average price in 1890, to $2.35, the average price of this year.

Mr. Benzenberg: What is the length of the guaranty?

Mr. Adam: Five years. The Board is not satisfied with a five year guaranty and I am now asked to prepare new specifications with ten year guaranty without naming any one kind of asphalt.

That, I think, will give full and fair competition, although I agree with what Mr. Benzenberg of Milwaukee has stated; it is not the material so much as the companies that are responsible. Of course every one concedes that it is manipulation as well as the quality of the material that it takes to make a good pavement, and that a poorer material can be used by a good company and produce a better result than good material by a poor company.

Mr. L. E. Farnham, Camden, N. J.: We have two hundred thousand dollars appropriated, bonds issued and bids in for asphalt pavements. In regard to the process of manufacture of these pavements, so far as I have been able to learn, it has for the last eighteen years laid with the asphalt companies. It is a manufactured product and the results depend upon the climatic changes, state of the foundation, quality of the residuum oil, sand and limestone, whether it is laid in summer or winter. These questions are answered by a correct preparation of the composition. There is no cook who makes a thousand loaves of cake exactly alike and no foreman who obtains a thousand yards of asphaltic pavement exactly alike. Though the formula of the composition has been decided upon by the chemist, the foremen depend largely upon their experience to vary the various amounts of residuum oil, sand, limestone and asphalt to suit particular conditions.

The results are not uniform in various cities even under the same management. For instance, in Scranton, Pa., where several miles of asphalt pavement have been laid during the past eight years, there is hardly a block of the old pavement which has not cracked, frequently every forty or fifty feet. In other cities, as on Broad street, Philadelphia, they have done magnificent work. The average City Engineer can hardly be held responsible for the quality of the material, when chemical authorities disagree in regard to the merits of the different asphalts. They seldom have the advice of a competent chemist, simply have the supervision of the laying, but are held responsible by the public for the making of the pavement. The question as to which is the best asphalt does not appear to be definitely settled. Almost any of the leading companies can show good work and yet so many failures have occurred that the results are not decisive.

The time limit of the guarantee is important. Many of the City Engineers are changing from a five-year guarantee to ten years. It was stated last year, it seemed to be the aim of the contractors to lay a pavement that would last for the five-year limit, and go to pieces soon afterward. I am more particularly interested in the form of the guarantee, the conditions to impose which the members have found to be the best. Is it a cash reservation on the contract price, real estate bonds or bonds. secured by some security company?

MR. ADAM: I will state that in Newark we require a ten-year guaranty bond of a Security company in half the amount bid for the work, conditioned that the pavement is kept in good order for ten years. Also a bond in the full amount bid, for the faithful performance of the work.

CAPT. BEACH: In Washington the guarantee consists of ten per cent. reservation upon the payments made—that is, taken out in cash and deposited in the treasury of the United States, at the disposal of the Commissioners of the District. If the pavement needs repairs, the contractor is notified that the work is needed, and if he doesn't make it promptly, then the money retained is used to make the repairs. If the contractor prefers, the money retained can be invested in interest-drawing bonds, and if he doesn't make the repairs promptly, then, of course, some of the bonds have to be sold to cover the cost. In addition to that, a guaranty bond is exacted in the full cost of the work by some responsible party—either some security company or parties who have real estate within the district available for action.

Mr. Benzenberg: I would like to ask Capt. Beach, What means do you take to make the repairs, if the contractor refuses to make them?

Capt. Beach: We have never had a case to arise on asphalt pavements. The companies that have had asphalt pavements in Washington are, the Warren, Starr, the Barber Asphalt Paving Company, and H. L. Cranford Company, and the Bermudez Company. There has never been any trouble with any of these companies with asphalt pavements. We have had considerable with other municipal concerns, and in that case there has never been a time when we had to go beyond the amount of money retained.

Mr. J. L. Kennedy, Nashville: Before we pass from this asphalt talk to brick pavements, I ask the Society to indulge me for a few moments. I want to present a gentleman, and to say for him, that he is a typical Nashville man, a gentleman, who has expended more money, more time, and, I might sav as much talk as anybody else in developing our Centennial Exposition, and I want to bring him forward and present him to you. Permit me to introduce to you Major McCann. He has some announcements to make.

Major J. J. McCann, Nashville: This is an honor which I least expected, and I regard it as a very great one. Brother Kennedy introduced me, Mr. President, as a citizen of Nashville, and I am only putatively so, I am really a citizen of the United States, and wherever that old flag floats I feel at home. (Applause.) And I want you to do the same while you are here. I come as the representative of the Tennessee Centennial. I should have been here this morning. My apology is, I have had a death in my immediate family, and that prevented me from being with you this morning, but my heart was with you, whether I was here in person or not.

Now, do not be alarmed when you look at the number of tags I have on. Nearly everybody tags me, and I am glad of it, but I don't want you for a moment to think I am in the condition that a man was who sent a very fine Scotch terrier by express, and he put a tag on the dog, but during the transit the dog chewed up the tag, and when he got to his destination the expressman said, "here's a dog, but darn me if I know who he belongs to, for he has chawed up his tag!"

I generally carry a number of them, so that, if I meet somebody and they do not recognize me in one State of the American Union, they do in the other.

I am pleased, gentlemen, to have met you here, on behalf of the Tennessee Centennial. We intend that you shall have a royal time while you are here. In fact, Mr. President, if you do not look sharp, before you get out of town you will be set on fire.

One of the problems with me is, that American cities have grown faster than the ability to properly govern, control and administer them. When I came out this afternoon and looked over this sea of faces, I commenced to scratch my head, and you will see I scratched the hair off the top of it. I said, here's talent enough to run all of them. Your coming to our city is of much more importance than you imagine. You understand that. There is no question which I have ever studied in my life but what some light has been thrown upon it by the companionship of my fellow-citizens. I never saw a man in my life, from whom I could not learn something; I never expect to see one from whom I cannot learn something; therefore concentrated thought, concentrated purpose and action, must necessarily bring about a fixed state of affairs in the ever-changing municipalities of the United States. Let us see how important that is, Mr. President. On the top of the Alleghany mountains, there is a little spring, or stream, which an ox could drink dry in a single day, but it trickles and winds along among the silence and solitude of the mountains until it meets other streams, and in another territory the same process is going on, until they get together and form, first the Monongahela and Alleghany rivers; when they get down to Pittsburgh they form the great Ohio; the Ohio comes rolling and gushing down until it is met by the Tennessee and Cumberland, and finally goes out into the "father of waters." So, then, the punctum saliens or starting point in the economic administration of the government of the United States must begin, gentlemen, at home. As Beecher, the great reformer, told us, Artemus Ward has brought it a little closer, by saying, "the only way in the world to start a reform association was for a fellow to start it himself." So that the only way we have now, gentlemen, of starting that general reform, and that general business economy essential to the success of the United States, is to begin right at the start. Where is that? First, the city—we might say the wards, and then the city; then the county; then the State, and then the United States, God bless them, from one end to the other. (Applause.)

So, then, we catch the idea. I will tell you what you find, gentlemen, when you come down to Tennessee; you will find people who feel like I and brother Kennedy, and our other city officers here, don't know where "Yankee Doodle" begins and where "Dixie" ends. (Applause.)

Our hearts are large: we are glad to see you: we feel that our city has been complimented; that our people have been enlightened, and when you get to the grounds—I extend a cordial invitation for you to go out there (and when I say that I can tell you we are going to have a good time), we will show you the grandest city on the American continent, Mr. President, a city which begun with Southern energy, which begun in Nashville, and which ends with Nashville. True, we have not as wise counsellors sometimes as persons would imagine exist in other cities, but we have got a very handsome looking lot of gentlemen, and they please the ladies, and whenever they do that, with the aid of the ladies, there is no tellling what we can accomplish in this life.

Now, I don't want to consume your time; you are away from home, and have got a good deal of business to attend to. At 7:30 o'clock I have got to make a speech to the Turn-Verein people, and in the morning I have got to take care of German-American day.

The President is absent, but in his absence you will find warm hearts and liberal hands, and—don't tell it outside the meeting—a pretty good tank-capacity. We are heartily glad to see you, we rejoice at your coming, feel honored by your coming, not only our State, but the whole United States; God bless each and every one of you. Do you understand that? I mean that; and you will find a lot of gentlemen who will bless you just as I do, and when you get through with your deliberations, and I get a little over the grief that exists in my family circle, we will have a good time together, all of us—especially Mr. Benzenberg, my Milwaukee friend over there, who I was introduced to at Milwaukee once; I had forgotten his name, and he had forgotten me; and we will say:

"Backward, turn backward, oh Time, in your way;
Make us boys again, just for to-day."

When you get through with business, we are going to take you out and show you the finest stock farm in the world, going to show you the finest panorama of beauty in the world. That's right. Our exposition is not as large as the Columbian Fair, but we have got a great many new features out there.

In addition to that I will tell you what we will do—without disparagement to the ladies in any other cities of the Union, we are going to show you the handsomest women in the world. Do you know why we are going to do that? We have got a specimen out there from every State in the Union. (Applause.)

I don't want to detain you; if I can serve you in any way, command me.

Will you please excuse me now? I will not say good-bye, but au revoir!

The President: I will say, Major McCann, the American Society of Municipal Improvements appreciates the welcome greeting you have extended to us, and we will so arrange our business as that it will allow all of us to take advantage of your very kind offer.

Mr. Thompson: I understand, the paper of Mr. Hathaway is not here. The next paper submitted is by Mr. Downing, of Indianapolis, Ind.

A FEW CONSIDERATIONS REGARDING WOODEN BLOCK PAVEMENTS.

BY M. A. DOWNING, CHAIRMAN BOARD OF PUBLIC WORKS, INDIANAPOLIS, IND.

At the meeting last year I read a short paper on wooden block paving, using creosoted wood. This met from certain interests, and some well-meaning members, sarcastic criticism, and, while I do not intend in any way to respond to such criticism, I am led to more fully state the grounds of my belief in wood pavements when properly selected, treated and laid, as the highest grade pavement, all things considered, that we have to-day, and in this statement I am not overlooking many good qualities possessed by asphalt, when properly selected, mixed and laid, nor of the good qualities of brick, when properly made, burned, selected and laid. Each have their place.

Before I go further, let me preface what I am going to say about wood pavements. I do not mean the kind of wood pavements that are at present current in the cities where there is any at all in the country. When we select wood for any of the multitudinous uses to which we put it, we give some attention to treatment and selection. We do not put green lumber into doors and window frames, nor on to the sides of houses, or even into the furniture of our offices and homes, without carefully selecting appropriate wood for the article intended, and then the most approved means of preserving the same from decay, by drying, painting, oiling, etc. When wood for these purposes is properly selected, treated and cared for, I think no one will deny its extreme usefulness and long life, nor its great strength. And, while architects and builders have given careful study to the selection and care of woods in construction, the same cannot be said of engineers and public officials, especially when the question of paving the streets with wood is considered. I ask how many of you have ever seen, or had experience with, wood pavements where nearly every one of these considerations has not been disregarded, from one cause or another, usually on the score of expense. To select green and wet wood, or only half seasoned, with the blocks round, sap wood and bark not removed, or only imperfectly removed, and lay such blocks on boards, or sand, or even concrete, with gravel in the joints, can hardly be called a street pavement as the conditions of life now call for a street pavement, and is not what I mean when I commend a wood pavement: but let me go a step farther and say that to select soft, inappropriate wood and lay the same with square blocks on a concrete foundation does not better the condition very much. It is, to use a homely comparison, like having a fine workman make an axe handle of white pine. The material is not suitable. Now I ask you, frankly, if the failures you have noted in wood block pavements have not been under such, or similar conditions. It is my purpose to indicate, in a general way, what I consider better conditions and the grounds for my belief.

In the first place, then, the wood itself has to be considered, the nature of traffic it will be called upon to bear, etc. Wood, when sound and well seasoned, especially any of the firmer woods, has very great strength; in fact, if a block of sound, well-seasoned yellow pine be submitted to alternate hammer blows, with a block of granite of like size, the wood will be in good condition when the granite is pounded into dust. It may be asked, then, why will not the wood last in the street longer than the granite? The answer is, that the granite possesses no qualities that will decay and weaken its strength by exposure to the elements, while wood has. Within the pores of the wood are the albumoids, which, under proper conditions of heat and moisture, ferment, and the block commences to rot, and its strength commences to depart: nor does the wood retain its pristine strength until we say "it is rotten," but part of that strength departs the moment the infection sets in, just as a man loses part of his strength the moment consumption has laid its blighting hand on him, although he may not die for a dozen years after; but if we can keep that block sound for ten or twenty years, it possesses, at the end of that time, as much capacity to resist load and abrasion as the day it was cut from the tree. Now the question comes—Can wood be so preserved, and if so, is it feasible to do it within the limit of reasonable cost? A careful examination of the experiments and processes adopted with the results obtained, answers the question in the affirmative. And while there are several processes that experience has shown will preserve wood fiber, the ONE process that is commonly accepted by all authorities that I have been able to consult, is creosoting, as no amount of moisture, or water, can wash it out of the cells of the wood, as is the case with at least some of the other preservatives. Creosote is the heavy oil of coal tar, and is the one article, when properly applied to piles used in Southern waters, that will exclude the dreaded Taredo, which destroys any wood not so treated in a very short time.

The United States commissioners to the Paris Exposition of 1889 made an exhaustive study of the subject of the "Preservation of Wood," and the same is embodied in their report—Vol. 2, from pages 715 to 754—and creosoting is most unqualifiedly approved. I quote from said report: "Creosoting timber with dead oil of coal tar (creosote oil), after the proper desiccation and preparation of the timber, is not a new patented process. It has been in successful use for over fifty years. The able report of the Committee on the Preservation of Timber of the American Society of Civil Engineers says: 'If the timber is to be exposed in a wet situation, creosoting is also the best process to use. If the exposure is to be that of a railroad tie (or the like) creosoting is doubtless the most perfect process in use.' Page 715. Creosoting is of especial value in preserving exposed timbers, telegraph poles, electric conduits, paving blocks, fence posts, etc. Page 717. Creosoting is by far the best method of preserving wood yet in use, both as to economy and endurance. Its success is hardly questioned in Great Britain and America. In Germany and France it is used extensively and successfully, and is replacing other methods. Page 738. As a preservative, creosoting holds its place alone. It is the only security against sea worms (taredo, etc). It prevents putrefaction and decay, and is not removed by water." The Department of Agriculture, Forestry Division, has issued a pamphlet (No. 9) in which the benefits and success of creosoting are strongly recommended and approved. As to cost, our experience is that the creosoted wood costs about the same as the asphalt.

I have carefully gone over the use of creosote as a preservative, and especially for paving blocks, and I make this statement and challenge its refutation: That not a well authenticated case can be shown, in this country or any other, where well-creosoted paving blocks have been laid, that have proven a failure.

Assuming, then, that wood can be preserved, the question arises, what kind of wood is best adapted, considering, availability, cost, strength, etc? My opinion is that the long leaf yellow pine of our Southern States (the short leaf is probably as good, but the fiber is not quite as strong), which takes the creosote excellently, for those cities where, by reason of its proximity, it is available, and the "Norway

Pine," or "Mountain Fir," for those cities where it is most available. The fiber of these woods is very strong, and they do not wear smooth and become slippery under traffic. The blocks should not be less than three inches thick. I think four is better. Four or five inches deep (with the grain of the wood), and from five to ten inches long. When such blocks of sound, well-selected wood, all sap wood excluded, are thoroughly creosoted, you have what I call very near an ideal paving material. but be sure the lumber is well seasoned and well treated with creosote. And when I say well treated, I don't mean dipped or pickled in creosote. The blocks should be placed in an air-tight cylinder and gradually heated to about 200 degrees F., and then live steam superheated to between 250 degrees and 400 degrees F. turned in. This steam penetrates the pores of the wood, seasons it, dissolves and cooks all of the albumoids in the wood. The vacuum pump should then be applied, and all steam and air drawn off. The result will be that the sap and water in the wood runs out and is drawn off. Then the creosote, heated to about 150 degrees F., should be turned in, and pressure applied until at least ten pounds of creosote to each cubic foot of wood is forced into the block. The creosote is then drawn off, and the blocks, when cool and dry, are ready to be laid on the street. If the traffic is heavy, the concrete should be laid perfectly smooth with a straight-edge, and the blocks laid close together on it, I think best at an angle of 45 degrees with the curb, but I am aware that in London and Paris this is not considered necessary. If the blocks are cut accurately (as to thickness and depth), and the laying well done, the surface is smoother than an asphalt pavement. The best paving pitch, or Portland cement grout, should fill the spaces between the blocks. If the traffic is medium, or light, I don't think it necessary to make the concrete perfectly smooth, but use a sand cushion, being careful to get a smooth surface with perfect drainage. You now have a pavement where five of the six sides of every block is secure from the destructive elements of air and water, by reason of its position, and the exposed surface practicably excludes all moisture, by reason of its treatment, and there is almost no expansion or contraction with well-creosoted wood; besides you have a sanitary pavement, as creosote is a perfect germicide and disinfectant. You have a pavement that will bear any kind of a load that it will be called upon to bear without injuring it. It is, besides, a very durable pavement. I have seen creosoted yellow pine block pavement in New Orleans and Galveston that, after over twenty years of wear, were in good condition, and the blocks in perfect condition, and to all appearances good for another twenty years. This was last year—the pavements are there yet for any one's inspection. I saw, in New Orleans, one pavement where the blocks were joined on to a granite pavement, and the granite had worn down one and three-fourths inches, while the yellow pine creosoted block had worn less than one-half inch in the twenty-two years of wear. and these pavements were not laid in the excellent way I am commending.

In Paris these pavements are the most popular of all pavements, constantly increasing in area, while the asphalt is decreasing. It is only proper to say that the creosoting in Paris is not so well done as here described. on the theory that if the yellow pine (from America) is well selected, properly seasoned, and slightly treated with creosote, and properly laid. it will last under the enormous traffic of that city (being many times heavier than that of any of our cities) until the blocks are worn out, and hence more creosote is necessary. The same theory obtains in London on streets of the heaviest traffic, while on other streets. where the traffic is lighter, the amount of creosote is increased. as the wood, if well selected, will not wear out in many years. Such streets are easily and cheaply repaired, the cost of repairing wood pavements in London and Paris, according to official reports, is only about one-fourth as much per yard per annum as it costs to repair the asphalt streets. These streets can be kept perfectly smooth for years. and do not develop waves and rough places, as many of our asphalt streets do in a few years.

I think most of you will agree with me that such a street as I describe comes nearer perfection than anything we know. It has a smooth surface and the sanitary conditions of the asphalt, without the glare, the heat. and the fine dust which comes from the asphalt. It is the quietest pavement, can be easily, cheaply, and perfectly repaired, if repaired in time, and it is work that the municipality can do itself after the guarantees have run out, something that cannot be done, at least in the present condition of the asphalt industry, with asphalt pavements. The conditions that are now pressing our cities are how to care for. maintain and clean our pavements, almost more than what material to pave with. and it is a question of ever-increasing importance, and I am convinced that it is of great importance that it shall be possible for each municipality to be able to do all repair and cleaning work itself. European cities have gone through all the vicissitudes of doing such work by contract, and finally found that the municipality can do such work more promptly, cheaper and better than by contract.

Wood is far easier for horses than any other pavement. It is very easily kept clean. in fact so easily that in my city we never have to sprinkle the wood pavements. and have no complaints about dust. We find that the creosote toughens the fiber of the wood. On two streets in our city soft wood, Washington cedar, was laid, without creosoting, and before a year many of the blocks had the corners broken by the pounding of horeses' feet. Subsequently other streets were to be laid with the same kind of wood, but the wood was treated with creosote, with the result that no corners of blocks are broken by the traffic.

However good, theoretically, a pavement is, intimate acquaintance with it, such as living on the street year after year, will discover a good many defects that to a casual observer do not appear, so that you may be quite sure of this fact—that if a majority of the residents on a paved street constantly complain about it, it is not a success; if quite a number complain, it is an indifferent success; and if the people living on the street are practically unanimous in their praise, the pavement is very much of a success. We have noticed this repeatedly in our city, and we can grade the pavements by the sentiment of the residents. Much more than a majority on macadam streets complain of mud when it is wet, and dust when it is dry. More than a majority on brick complain of the great noise, and, although brick started out with great promise of popularity in our city, in the course of two or three years petitions for the same fell off, so that now we are seldom asked to lay a brick pavement except in alleys. The asphalt has many friends with the public at large, on account of many excellent qualities. The opposition to it comes mostly from the residents on the streets where it is laid. They complain of the fine dust that accumulates on it, and the glare and heat in summer, and the wavy surface after a few years' wear. In regard to our creosoted wood pavements, the only complaints that we have ever had was on account of the paving pitch on the surface when first laid, which, of course, wore off in a short time. The comments of the people on those streets are practically unanimous in its praise. Of the miles of such pavements that we have, I do not know of a single instance of a resident being dissatisfied with the pavement, and what higher encomium can be passed than that it is a success with the people?

THE PRESIDENT: The next on the programme is the paper, "Rumbling in Brick Pavements," by Mr. Adam.

MR. ADAM: I will say to the Society, that it is a very brief paper, and I won't keep them very long. I received a letter from the Chairman of the Street Paving Committee about six weeks ago, in which he requested me to prepare some paper on street paving; I was very busy and I didn't think I could spare the

354309

time, and he entreated me to continue the subject that I submitted to the convention last year, which I have done in the following way:

Mr. Adam then read the following paper:

RUMBLING IN BRICK PAVEMENTS.

BY ERNEST ADAM, CITY ENGINEER, NEWARK, N. J.

The Chairman of the Committee on Street Pavings requested me to again take up the subject of "Rumbling in Brick Pavements," which, as will be remembered, was treated of in a paper presented at the convention held last year.

The subject does not admit any strange or startling developments, yet, like all other matters which relate to municipal improvements, can bear consideration and discussion.

It was stated in my previous paper that our experience with the first brick pavements laid in the city of Newark, all of them having the interstices filled with hydraulic-cement grout, was a discouraging one.

Soon after the pavements were finished, a rumbling noise emanated from them; it was quite annoying to the residents. The property owners upon one of the streets attempted to have the assessment for the pavement set aside by the court. Upon an investigation of the cause of the rumbling, I came to the conclusion that it was principally produced by the expansion of the paving-brick; I think that this opinion was clearly demonstrated in the paper which was presented last year.

It therefore became necessary to adopt a method, in case the hydraulic-cement grout was to be retained, which would allow for the expansion in the paving-brick, and so, perhaps, remove the nuisance caused by the rumbling noise.

The method which was adopted in the laying of a brick-pavement in 1896, to obviate this difficulty, was also described by me. The time between its completion and the convention of last year was too short to enable me to state the practical result of the experiment. It is now a little more than a year since the pavement was completed. During the hottest summer days I made a number of examinations, and found that the provisions made for expansion had prevented any bulgings such as were found in the first pavements laid, and, although it is not entirely free from the rumbling noise, yet it is so diminished that none of the residents on the street have made complaint.

During the same year, three other streets were paved with brick, but not having time to await the result of the experiment made in the first, the interstices were filled with sand in two cases, and in the other with paving pitch. As one of the streets had a four per cent. grade, I was afraid, like an Engineer of one of the Western cities, that the sand would be washed out, especially along the gutters; but this did not happen. I could not risk to grout a strip along the gutters, after I had seen the evil effects of this in another city. Of course, no rumbling noise was experienced in either of those streets. It, therefore, might be justly asked, why not use sand or paving-pitch instead of hydraulic-cement grout. In my opinion, the use of the latter material ensures a greater durability of the pavement than when a sand filler is used, setting sanitary conditions aside. It is even more durable than when paving-pitch is adopted.

The results of using sand are already demonstrated by the condition of the pavements, after a wear of only one year. Although the bricks were laid so close that the space between them is only about ⅛ of an inch, yet the edges are considerably worn off.

The rapid wear of these pavements prompted the Board of Street and Water Commissioners to again fall back to the use of hydraulic-pavements contracted for this year. But, instead of only filling a strip of 1½ to 2 inches along the curbs, and one of 15 feet at each end and in the middle of the block, with paving-pitch, I ordered a strip of one foot in width to be poured every fifty feet in one of the blocks, and every twenty-five feet in the other, in addition to the strip along the curbs.

This was done in order to fully allow for expansion, and prevent the evil results of a rumbling noise.

One of the pavements done in this manner was completed a month ago. I have since driven over it several times when the thermometer indicated 95 degrees temperature in the shade, and noticed no rumbling.

One of the principal reasons why brick-pavements were introduced in this city, was to create a competition with asphalt pavements, and consequently a reduction in price per square yard.

If the cost per square yard of good asphalt pavement would be reduced in this city to that obtained in other cities, Brooklyn for example, or even to the cost of brick pavement, then, I think, there would be very little demand for the latter kind, although there is in its favor that it is less slippery than asphalt pavement.

THE PRESIDENT: I have just received the following communication from the Engineering Association of the South, which reads as follows:

OCTOBER 4TH, 1897.

TO THE MEMBERS OF THE AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENT:

GENTLEMEN:

The Engineering Association of the South has headquarters in this city at No. 150 North Cherry street, not far from the Maxwell House. There are kept on file the latest publications on engineering and kindred topics. We beg to tender you, during your stay in the city, the use of these rooms, and trust that you will have an opportunity to avail yourself of this invitation.

Very respectfully,
C. A. LOCKE,
President,
LUCIUS P. BROWN,
Secretary,
W. M. LEFTWICH. Jr.,
Treasurer.

MR. LEWIS, Brooklyn: I move that the Secretary be authorized to extend the Society's appreciation for the courtesy of this invitation. Motion seconded, and adopted unanimously.

THE PRESIDENT: I will say that if we meet promptly at 8 o'clock this evening, we may get through in about an hour.

The convention here adjourned until 8 p. m.

TUESDAY, OCTOBER 5th, 1897. EVENING.

The convention was called to order at 8 o'clock p. m., President August Herrmann in the chair.

THE PRESIDENT: The first thing on this evening's program will be the report of the Committee on Electric Street Lighting.

MR. CABOT: The report gives in detail the average of every city, the total averages for 46 cities, the total average hours per year is 3,200.

Mr. Cabot here read the following report:

REPORT OF COMMITTEE ON ELECTRIC STREET LIGHTING.

Collecting data by correspondence is one of the most difficult and unsatisfactory tasks known. You who have collected data in this manner on any subject well know how annoying and discouraging it is to receive your question blanks only half filled out, and in nine cases out of ten not even returned. The trouble lies in the lack of interest taken in the matter by the parties receiving your letters and blanks.

The blank is generally sent to the Mayor, the President of the most prominent board, or head of a department; they are usually too busy to give it their personal attention, therefore refer it to their head clerk, and the head clerk, in his turn, quite frequently consigns it, to the waste basket.

Last year, out of 1.800 letters and blanks sent out by your committee, 171 were answered, and of that 171 only 19 were complete in detail; it is very discouraging, to say the least.

I have to admit it is considerable trouble to fill out the general run of question blanks usually received by city officials.

This is a plea to members of this association, that when they receive such a blank from the Electric Light Committee, in fact from any committee of this association, to do their utmost to have every question answered as accurately as possible.

Your committee did not send out any question blanks this year, for two reasons:

1st. There is generally very little change in the answers to the same questions if sent out two years in succession, and as the life of municipal contracts for electric light average three years, we did not think this committee was justified in spending the society's money for practically the same data.

2d. In the early part of this year we were informed that the General Electric Company was collecting data on arc lighting, and it would be available for this society at this convention. We have rearranged and tabulated this information, and now present it.

This data has been arranged from reports from three hundred and ninety-seven cities and forty-six states.

The questions are few, but to the point, showing the population, number of lamps, candle power of lamps, schedule, hours per year, cost of coal per ton, contract price per lamp per year, cost per lamp per hour, and candle power per hour for one cent, also the averages of all these questions in each state, and total averages:

251 cities use 2,000 candle-power lamps,
156 " " 1,200 " " "
2 " " 1,800 " " "
6 " " 1,600 " " "
1 " " 3,000 " " "
1 " " 1,500 " " "

Schedule—

235 cities use all-night schedule,
94 " " moonlight "
23 " " midnight "
9 " " the Philadelphia system.

Maximum hours, lighting, per year, 4,000,
Minimum " " " " 1,220.

Fuel—

321 cities use coal,
52 " " water-power,
13 " " wood,
7 " " gas,
1 " " oil.

Maximum price for coal per ton,	Reno, Nev	$9.50
Minimum price for coal per ton,	Weir City, Kan., Nelsonville, O	.40

Contract price per lamp per year:

Maximum	$201.00	San Francisco, Cal.
Minimum	50.00	Auburn, Me. Skowhegan, Me. Newport, N. M. Jordan, N. Y. Appleton, Wis.

Price per lamp hour, per year:

Maximum	$.083	Durango, Col.
Minimum	.01	Big Rapids, Mich.

Candle power for one cent:

Maximum	1,950	Big Rapids, Mich.
Minimum	150	Taunton, Mass.

The two columns. "Cost per lamp per hour" and "Candle power per hour for one cent." will enable comparison to be made, as they reduce all schedules and candle-power lamps to a unit basis.

Respectfully submitted,

J. A. CABOT,
J. H. PEARSON.

MR. ROSEWATER: I notice one important factor that seems to be left out in the account, and that is the fact of the area of the city covered; some cities are spread out over enormous areas, that cover three or four times the area of other cities, and the density of population of the different cities has a great deal to do with the cost of service; it takes a great deal more wire and more coal.

MR. CABOT: That is very true.

ARC LIGHTING STATISTICS.

LOCATION.	Population.	Number of Lamps.	Candle Power.	SCHEDULE.	Hours per Year.	Coal per Ton.	Contract Price per Lamp, per Year.	Cost per Lamp per Hour.	CandlePow. per Hour for 1 Cent.
ALABAMA.									
Anniston	12,000	48	1,200	All—every night	4,000	$ 1.50	$ 75.00	.019	640
Birmingham	50,000	152	2,000	All—every night	4,000	.54	108 00	.018	1,129
Eufalia	6,000	37	1,200	All night	3,868	2.25	86.50	.022	536
Mobile	40,000	180	2,000	All—every night	4,000	2.25	69.50	.017	1,150
Montgomery	30,000	158	1,200	All—every night	4,000	2.50	87.00	.022	552
....	....	50	2,000	All—every night	4,000	2.50	108 00	.027	740
				Average	3,978	$ 1.92	$ 89.00	.021	791
ARKANSAS.									
Camden	5,675	14	1,200	All—every night	4,000	$ 2.65	$ 144.00	.036	333
Jonesboro	5,000	23	1,200	All—every night	4,000	2.75	120.00	.03	400
				Average	4,000	$ 2.70	$ 132.00	.033	366
CALIFORNIA.									
Napa	5,000	20	1,200	1 o'clock	2,190	$ 6.40	$ 120.00	.055	219
		6	1,200	1 o'clock	2,190	6.40	108.00	.049	243
Oakland	75,000	500	2,000	Moonlight, 6 mo. All night, 6 mo.	2,700	5.25	121.50	.045	445
Pasadena	12,000	57	2,000	All night dark nights	3,680	Oil.	123.00	.033	597
....	....	34	1,200	All night dark nights	3,680	Oil.	114.00	.031	645
Petaluma	5,000	27	2,000	Moonlight	2,179	8.00	108.00	.05	403
Redlands	6,500	20	2,000	All night	4,000	W. P.	108.00	.027	740
San Bernardino	8,000	74	2,000	All night	4,000	6.00	78.00	.02	1,020
San Diego	20,000	120	2,000	Moonlight	2,179	9.00	150.00	.069	290
San Francisco	335,000	622	2,000	All night	4,000	6.00	201.00	.05	398
San Louis Obispo	3,502	18	1,200	Moonlight	2,179	9.00	84.00	.039	311
Visalia	4,000	20	1,200	Moonlight to 1 o'clock	1,550	Wood.	120.00	.077	155

COLORADO.

Aspen	7,000	51	2,000	All—every night	4,000	W. P.	$ 90.00	.023	890
Colorado Springs	22,000	101	2,000	Moonlight	2,179	$ 2.00	108.00	.05	403
Creede	1,500	11	2,000	Moonlight	2,179	5.75	144.00	.066	302
Cripple Creek	20,000	65	2,000	All night	4,000	6.00	185.40	.046	431
Durango	5,500	20	2,000	Moonlight	2,179	1.00	180.00	.083	242
Florence	3,500	13	2,000	All night	4,000	.75	156.00	.039	513
Fort Collins	3,000	17	2,000	All night	4,000	2.50	120.00	.03	666
Glenwood Springs	1,000	11	2,000	All night	4,000	W. P.	120.00	.03	666
Grand Junction	4,000	6	2,000	All night	4,000	2.00	120.00	.03	666
Highlands	15,000	33	2,000	All night	4,000	1.35	100.00	.025	800
Leadville	12 000	39	2,000	All night	4,000	2.50	168.00	.042	476
Longmont	2,400	10	2,000	Midnight	1,825	2.00	120.00	.066	304
Manitou	2,000	15	2,000	Moonlight to 1 o'clock	1,550	2.85	126.00	.081	246
Ouray	2,800	13	2,000	Midnight	1,825	5.00	120.00	.066	304
Pueblo	33,000	155	2,000	All night	4,000	....	132.00	.033	606
Salida	3,500	11	2,000	All night	4,000	6.00	150.00	.038	533
Telluride	2,500	7	2,000	All night	4,000	7.50	72.00	.018	1,110
Trinidad	6,000	40	2,000	All night	4,000	6.25	132.00	.033	606
....	....	7	2,000	All night	4,000	6.25	120.00	.03	666
Walsenburg	1,000	4	2,000	All night	4,000	.75	150.00	.038	533
				Average	3,387	$ 3.00	$ 130.67	.043	548

CONNECTICUT.

Anaonia	....	....	....	....	....	....	....	....	....
Derby	20,000	139	1,200	12:30, (26 nights)	1,720	W. P.	$ 60.00	.035	344
Shelton	....	....	....	....	....	....	....	....	....
Bridgeport	60,000	375	1,200	All—every night	4,000	$ 3.15	102.00	.026	470
Bristol	6,000	55	2,000	12 ex. f. m	1,650	3.50	90.00	.055	367
Naugatuck	10,000	75	1,200	1 o'clock	2,190	4.10	75.00	.034	348
New Britain	23,000	119	2,000	1 o'clock	2,190	6.00	93.00	.042	472
Norwich	18,000	158	1,200	All—every night	4,000	4 30	90.00	.026	534
Putnam	6,700	75	1,200	Midnight	1,825	6.25	75.00	.041	292
Stafford Springs	5,000	11	1,200	11 o'clock	1,460	5.00	62.50	.043	280
Thomsonville	5,000	38	2,000	Moonlight	2,179	4.60	80.00	.037	544
Waterbury	40,000	117	2,000	All night	4,000	4.00	109.50	.027	730
....	....	65	1,200	....	....	....	....	....	....
				Average	2,521	$ 4.54	$ 83.70	.036	438

ARC LIGHTING STATISTICS.—Continued.

LOCATION.	Population.	Number of Lamps.	Candle Power.	SCHEDULE.	Hours per Year.	Coal per Ton.	Contract Price per Lamp, per Year.	Cost per Lamp per Hour.	CandlePow. per Hour for 1 Cent.
				DELAWARE.					
Wilmington	70,000	152	2,000	All night	4,000	$ 2.32	$ 110.00	.028	728
				DISTRICT OF COLUMBIA.					
Washington	250,000	506	1,200	All—every night	4,000	....	$ 106.00	.027	452
				FLORIDA.					
Fernandina	2,500	19	1,200	Moonlight	2,179	Wood.	$ 117.65	.054	222
				GEORGIA.					
Augusta	46,000	314	2,000	All—every night	4,000	W. P.	$ 70.00	.075	1,141
Columbia	19,303	120	2,000	Moonlight	2,179	$ 2.00	85.00	.039	512
La Grange	3,500	33	2,000	All night	4,000	1.60	90.00	.023	890
Newman	3,500	26	2,000	All night	4,000	1.80	100.00	.025	800
Savannah	65,409	310	1,200	All night, 3 nights off	3.680	3.00	90.00	.024	490
Waycross	6,500	36	3,000	Moonlight	2,179	Wood.	66.66	.031	654
				Average	3,339	$ 1.40	$ 83.31	.036	748
				IDAHO.					
Boice	7,500	47	2,000	All night	4,000	W. P.	$ 108.00	.027	740
Wallace	2,000	11	2,000	All night	4,000	W. P.	120.00	.03	666
				Average	4,000	....	$ 114.00	.029	703

ILLINOIS.

Beardstown	6,000	47	1,200	Philadelphia	2,250	$ 1.50	$ 64.80	.029	416
Belleville	19,000	138	2,000	Moonlight	2,179	.05	80.00	.037	544
Cairo	15,000	28	2,000	Midnight	1,825	1.75	64.80	.036	563
Carbonville	3,500	28	1,200	All—every night	4,000	1.50	72.00	.018	667
Charleston	7,000	64	2,000	All—every night	4,000	.50	90.00	.023	890
Danville	16,000	121	2,000	Moonlight	2,179	.60	80.00	.037	544
Dixon	8,000	25	2,000	All night	4,000	2.25	90.00	.023	890
Gibson City	2,500	4	1,200	Moonlight	2,179	1.70	84.00	.039	311
Havana	3,000	42	2,000	Philadelphia	2,250	.90	72.00	.032	625
Highland Park	3,500	60	1,200	Moonlight	2,179	3.20	60.00	.037	436
Lincoln	10,000	62	2,000	Moonlight	2,179	.50	60.00	.028	725
....	....	20	2,000	All night	4,000	.50	70.00	.018	1,140
Litchfield	6,500	43	2,000	Philadelphia	2,250	1.25	75.00	.033	600
Mt. Vernon	7,000	48	2,000	All—every night	4,000	.85	90.00	.023	890
Pickneyville	3,000	25	1,200	Moonlight	2,179	.75	85.00	.039	306
Princeton	5,382	11	1,200	11 o'clock	1,460	.80	72.00	.049	244
Quincy	45,000	258	2,000	Philadelphia	2,250	1.00	75 00	.033	600
				Average	2,668	$ 1.19	$ 76.74	.031	611

INDIANA.

Alexandria	7,000	30	2,000	All—every night	4,000	Gas.	$ 90.00	.023	890
Auburn	3,000	18	1,200	Midnight	1,825	$ 2.40	60.00	.033	365
Cambridge City	2,500	40	1,500	Midnight	1,825	1.85	75.00	.041	365
Crown Point	2,500	22	1,200	Midnight	1,825	1.60	76.00	.042	288
Decatur	3,500	33	2,000	Moonlight	2,179	2.25	80.00	.037	544
Ft. Wayne	49,000	260	2,000	Philadelphia	2,250	2.00	120.00	.053	375
Hartford	6,000	50	2,000	All night	4,000	Gas.	60.00	.015	1,332
Indianapolis	185,000	1,100	2,000	Moonlight	2,179	1.25	85.00	.039	511
Kokomo	10,500	101	2,000	All—every night	4,000	Gas.	80.00	.02	1,000
Ligonier	2,500	70	1,600	Moonlight	2,179	3.10	70.00	.032	498
Madison	10,000	92	1,600	Moonlight	2,179	1.15	80.00	.037	436
Monticello	2,000	21	2,000	All—every night	4,000	1.10	100.00	.025	800
Peru	10,000	66	2,000	All night	4,000	Gas.	82.50	.021	970
Rochester	4,500	44	1,200	Midnight	1,825	1.55	70.00	.038	313
Rockville	2,000	27	2,000	Moonlight to 1 o'clock	1,550	1.50	70.00	.045	443
South Bend	30,000	157	2,000	Midnight	1,825	2.25	70.00	.038	522
....	....	56	2,000	All night	4,000	2.25	90.00	.023	890
Union City	4,000	32	2,000	Moonlight	2,179	Gas.	92.00	.042	472
Vincennes	12,000	10	1,200	Midnight except Sundays	1,400	.65	96.00	.069	175
				Average	2,590	$ 1.78	$ 81.39	.035	589

ARC LIGHTING STATISTICS.—Continued.

LOCATION.	Population.	Number of Lamps.	Candle Power.	SCHEDULE.	Hours per Year.	Coal per Ton.	Contract Price per Lamp, per Year.	Cost per Lamp per Hour.	CandlePow. per Hour for 1 Cent.
IOWA.									
Albia	3,000	29	2,000	All night except moonlight	3,680	$ .65	$ 80.00	.022	920
Belle Plain	3,500	18	2,000	Moonlight	2,179	1.00	84.60	.039	514
Burlington	30,000	122	2,000	Moonlight	2,179	.95	100.00	.046	435
Clinton	25,000	99	2,000	All night	4,000	1.25	90.00	.023	890
Des Moines	80,000	158	2,000	Moonlight	2,179	1.00	96.00	.044	453
....	....	139	2,000	All night	4,000	1.00	126.00	.032	635
Ft. Dodge	10,000	51	1,200	All dark nights	3,680	1.50	95.00	.026	465
Grinnell	4,000	28	2,000	Moonlight	2,179	1.85	83.33	.038	522
Le Mars	5,500	16	1,200	Moonlight	2,179	2.15	75.00	.034	348
Ottumwa	18,000	120	2,000	All night	4,000	.85	80.00	.02	1,000
Sioux City	30,000	100	2,000	Philadelphia	2,250	2.30	95.00	.042	474
				Average	2,955	$ 1.32	$ 91.36	.033	605
KANSAS.									
Atchison	15,500	7	2,000	All night	4,000	$ 2.30	$ 144.00	.036	555
....	....	60	2,000	Moonlight-midnight	1,220	2.30	72.00	.059	339
Beloit	2,000	13	1,200	Moonlight-midnight	1,220	3.50	77.00	.063	190
Council Grove	2,500	14	1,200	Every night-midnight	1,825	3.00	75.00	.041	292
Ft. Scott	12,000	75	2,000	Philadelphia	2,250	1.05	84.00	.037	530
Hutchinson	8,324	34	2,000	Moonlight	2,179	2.50	100.00	.046	435
....	....	50	2,000	All night	4,000	1.50	144.00	.036	555
Kansas City	46,696	50	2,000	All night	4,000	1.50	132.00	.033	606
....	....	40	2,000	All night	4,000	1.50	119.00	.030	672
Lawrence	10,000	21	2,000	Every night-midnight	1,825	2.75	96.00	.053	380
Leavenworth	22,000	70	2,000	All—every night	4,000	1.50	96.00	.024	832
McPherson	3,000	18	2,000	Moonlight-midnight	1,220	2.30	60.00	.049	407
Parsons	8,115	48	2,000	All—every night	4,000	1.25	84.00	.021	950
Weir City	6,000	15	2,000	All night	4,000	.40	100.00	.025	800

KENTUCKY.

Cattlesburg	3,500	45	2,000	All night	4,000	$ .60	$ 64.44	.016	1,240
Dayton	10,000	41	2,000	All night	4,000	1.00	90.00	.023	890
Louisville	215,572	1,219	2,000	3840 hours	3,840	1.00	84.00	.022	915
Mt. Sterling	5,000	31	1,200	Moonlight	2,179	1.60	100.00	.046	261
Versailles	3,500	24	1,200	Moonlight	2,179	2.00	90.00	.041	291
Newport	50,000	108	2,000	Moonlight	2,179	1.00	100.00	.046	435
				Average	3,063	$ 1.20	$ 88.07	.032	672

LOUISIANA.

New Orleans	275,000	1,384	2,000	All night	4,000	$ 2.38	$ 127.50	.032	627

MAINE.

Auburn	12,500	90	2,000	Moonlight	2,179	W. P.	$ 50.00	.023	870
Berwick Village	600	12	1,200	Moonlight-midnight	1,220	W. P.	80.00	.066	183
Berwick Town	2,500								
Brewer	5,000	14	1,200	All—every night	4,000	$ 5.00	75.00	.019	640
Calais	7,500	42	2,000	Every night-midnight	1,825	W. P.	60.00	.033	608
Rumford Falls	3,000	30	1,200	All night	4,000		90.00	.023	534
Skowhegan	5,280	34	1,200	Length of Carbon	2,555	W. P.	50.00	.02	613
				Average	2,630	$ 5.00	$ 67.50	.031	575

MASSACHUSETTS.

Abington	4,500	32	1,200	Moonlight	2,179	$ 4.25	$ 66.00	.03	397
Rockland	5,500								
Amesbury	10,000	67	1,200	Moonlight to 1 o'clock	1,550	3.65	75.00	.048	248
Amherst	5,000	30	1,200	Moonlight-midnight	1,220	4.20	90.00	.074	163
Andover	6,000	31	1,200	Moonlight	2,179	4.20	74.50	.034	351
Arlington (See Somerville)									
Athol	7,364	75	1,200	Moonlight-midnight	1,220	6.25	75.00	.061	195
Attleborough	8,388	68	1,200	Moonlight-12:30	1,385	3.85	75.00	.054	222
Beverley	13,000	90	1,200	12 o'clock-25 nights	1,500	3.25	90.00	.06	200
Boston	500,000	2,566	2,000	All night	4,000	4.00	127.75	.032	626
Brockton	33,165	254	1,200	All night	4,000	3.70	83.00	.021	578
Fitchburgh	26,409	225	1,200	All night	4,000	4.00	120.00	.03	400
Franklin	5,133	42	1,200	Moonlight-midnight	1,220	4.20	75.00	.062	195
Haverhill	35,000	176	2,000	All night	4,000		131.00	.033	610
Holyoke	44,153	246	1,200	All—every night	4,000	5.70	100.00	.025	480

ARC LIGHTING STATISTICS.—Continued.

LOCATION.	Population.	Number of Lamps.	Candle Power.	SCHEDULE.	Hours per Year.	Coal per Ton.	Contract Price per Lamp, per Year.	Cost per Lamp per Hour.	CandlePow. per Hour for 1 Cent.
MASSACHUSETTS.—Continued.									
Lawrence	52,154	96	2,000	All—every night	4,000	$ 4.00	$ 100.00	.025	800
		114	1,200	All—every night	4,000	4.00	90.00	.023	890
Lowell	90,000	440	2,000	All night	4,000	4.25	128.00	.032	625
Malden	32,000	91	1,200	Moonlight	2,179	3.55	90.00	.041	290
		19	1,200	All night	4,000	3.55	105.00	.026	457
Milford	8,952	45	1,200	6 nights 11:30-1 night 12:00	1,668	4 25	100.00	.06	200
Nantucket	4,000	25	1,200	Moonlight-11 o'clock	1,550	4.00	96.00	.062	193
New Bedford	65,000	190	2,000	Moonlight	2,179	2.00	138.75	.064	314
Newburyport	14,532	145	1,200	Moonlight	2,179	3.85	73.50	.034	355
Newton	27,590	158	1,200	All—every night	4,000	4.50	109.50	.027	438
Northampton	16,746	129	1,200	Moonlight	2,179	4.50	67.50	.031	388
		20	1,200	All night	4,000	4.50	86.25	.022	557
Orange	5,500	49	1,200	Every night-midnight	1,825	W. P.	75.00	.041	292
Palmer	4,000	40	1,200	Midnight	1,825	W. P.	75.00	.041	292
Warren	7,000	75	1,200	Midnight	1,825	W. P.	75.00	.041	292
Salem	34,473	160	2,000	All night	4 000	3.00	140.00	.035	571
Arlington	56,000	81	1,200	Every night-1 o'clock	2,400	3.50	90.00	.038	320
Southbridge	8,240	70	1,200	Moonlight	2,179	4.00	76.35	.035	342
Springfield	51,522	472	1,200	All—every night	4,000	4.00	75.00	.019	640
Taunton	28,000	116	2,000	Moonlight to 1 o'clock	1,550	4.50	124.00	.016	160
Turners Falls	4.500	19	1,600	1 o'clock	2,190	W. P.	99.40	.045	353
Waltham	20,876	130	1,200	1 o'clock	2,190	4.00	83.95	.038	313
Ware	8,000	40	1,200	Moonlight	2,179	4.40	73.00	.034	358
		8	1,200	Moonlight	2,179	4.40	60.00	.028	435
Webster	7,500	56	1,200	Midnight	1,825	4.25	80.00	.044	274
Weymouth	11,000	33	1,200	Moonlight	2,179	3.50	70.00	.032	373
Whitman	6,000	26	1,200	1 o'clock	2,190	5.00	80.00	.037	329
Winchendon	4,500	25	1,200	Moonlight	2,179	....	75.00	.034	314
				Average	2,503	$ 4.07	$ 79.12	.037	386

MARYLAND.

MICHIGAN.

Allegan	3,000	13	1,200	Moonlight	2,179	W. P.	$ 60.00	.028	435
Ann Arbor	14,500	102	2,000	Moonlight-12:30	1,815	$ 2.50	60.00	.033	606
Battle Creek	16,000	126	2,000	Midnight	1,825	3.00	57.00	.031	640
....	....	31	2,000	All night	4,000	3.50	69.00	.017	544
Big Rapids	5,200	50	2,000	All night	4,000	W. P.	41.00	.01	1,950
Cheboygan	7,000	17	1,200	All night	4,000	W. P.	......	.02	608
....	....	24	1,200	1 o'clock	2,190	W. P.	79.00	.036	333
Eaton Rapids	2,600	20	1,200	Every night-midnight	1,825	W. P.	72.00	.04	304
Hancock	4,000	16	2,000	All—every night	4,000	2.75	102.00	.026	785
Houghton	4,000	16	2,000	All—every night	4,000	2.75	102.00	.026	785
Ishpeming	13,000	59	2,000	All—every night	4,000	3.20	108.00	.027	740
Jackson	30,000	230	2,000	All night	4,000	2.10	70.00	.018	1,140
Lake Linden	4,000	14	2,000	All—every night	4,000	2.75	102.00	.026	785
Mt. Clemens	6,000	45	2,000	All dark nights	3,680	2.70	75.00	.02	980
Negaunee	6,000	31	2,000	All night	4,000	3.20	108.00	.027	740
Red Jacket	10,000	20	2,000	All—every night	4,000	2.75	102.00	.026	785
Sault Ste. Marie	8,500	73	1,200	All—every night	4,000	2.77	66.00	.017	727
St. Johns	3,500	37	1,200	Moonlight	2,179	2.30	57.60	.027	454
Tecumseh	2,500	40	1,200	All—every night	4,000	2.00	65.00	.016	738
				Average	3,352	$ 2.69	$ 77.54	.025	741

MINNESOTA.

Duluth	60,000	496	2,000	All—every night	4,000	$ 2.00	$ 109.50	.027	730
Hastings	4,000	12	2,000	Midnight	1,825	2.50	96.00	.053	380
....	....	5	2,000	....	....	2.50	90.00	.049	405
Mankato	12,000	45	2,000	All night	4,000	3.65	96.00	.024	834
Pipestone	2,000	9	1,200	Moonlight	2,179	3.25	108.00	.05	242
Saginaw	50,000	157	2,000	All night	4,000	2.00	95.00	.024	842
Sauk Centre	3,000	15	2,000	3 o'clock	2,645	8 00	100.00	.038	530
Spring Valley	2,000	6	1,200	11:30 o'clock	1,640	3 10	72.00	.044	273
				Average	2,898	$ 3.38	$ 93.31	.039	600

MISSISSIPPI.

Meridian	15,000	100	1,200	Moonlight	2,179	$ 1.80	$ 96.00	.044	272
Vicksburg	18,000	81	2,000	Moonlight	2,179	1.95	102.00	.047	427
Yazoo City	5,000	25	2,000	Moonlight	2,179	3.25	108.00	.05	403
				Average	2,179	$ 2.33	$ 102.00	.047	367

ARC LIGHTING STATISTICS.—Continued.

LOCATION.	Population.	Number of Lamps.	Candle Power.	SCHEDULE.	Hours per Year.	Coal per Ton.	Contract Price per Lamp, per Year.	Cost per Lamp per Hour.	CandlePow. per Hour for 1 Cent.
				MISSOURI.					
Aurora	5,000	20	1,200	Moonlight	2,179	$ 2.25	$ 87.50	.04	299
Brookfield	6,062	18	1,200	Philadelphia	2,250	1.40	72.00	.032	375
Butler	4,000	21	2,000	Moonlight	2,179	1.00	66.66	.031	653
Clinton	7,000	45	2,000	Moonlight	2,179	1.85	85.00	.039	512
Jefferson	10,000	43	2,000	All—every night	4,000	1.75	123.00	.031	650
Joplin	14,000	55	2,000	All night	4,000	W.P.&S.	72.00	.018	1,110
Kansas City	175,000	208	2,000	All night	4,000	2.00	110.00	.028	726
Memphis	2,500	15	1,200	Moonlight	2,179	9.00	66.00	.03	396
Richmond	3,500	20	2,000	Midnight	1,825	1.75	85.00	.047	430
Sedalia	22,000	100	2,000	All—every night	4,000	3.50	63.50	.016	1,260
Willow Springs	1,575	2	1,600		1,460	Wood.	96.00	.066	243
				Average	2,696	$ 2.72	$ 84.24	.034	605
				MONTANA.					
Billings	3,000	10	1,200	All night	4,000	W. P.	$ 120.00	.03	400
		8	1,200	All night			108.00	.027	444
Bozeman	4,000	23	1,200	All night	4,000	$ 2.00	138.00	.035	348
Great Falls	12,000	42	2,000	All night	4,000	W. P.	108.00	.027	740
Missoula	5,000	20	1,200	All night	4,000	6.00	180.00	.045	266
				Average	4,000	$ 4.00	$ 130.80	.033	440
				NEBRASKA.					
David City	2,300	14	1,200	Philadelphia	2,250	$ 2.65	$ 100.00	.045	270
Grand Island	10,000	1	2,000	All night	4,000	3.50	144.00	.036	555
Lincoln	50,000	176	2,000	Midnight	1,825	1.90	96.00	.056	380
		20	2,000	All night	4,000	1.90	120.00	.03	666
				Average	3,019	$ 2.49	$ 115.00	.042	468
				NEVADA.					
[illegible]	[illegible]	[illegible]	[illegible]	All dark hours	[illegible]	$ 0.50	$ 144.00	[illegible]	[illegible]

NEW HAMPSHIRE.

Berwick	3,000	12	1,200	Moonlight-midnight	1,220	W. P.	$ 67.00	.055	219
				All night	4,000	W. P.	87.00	.022	551
Claremont	6,000	47	1,200	Midnight	1,825	$ 4.40	68.00	.037	322
Derry	3,000	28	1,200	Moonlight	2,179	4.25	63.50	.029	412
Dover	13,000	130	1,200	All night	4,000	W. P.	87.00	.022	551
				Moonlight-midnight	1,220	W. P.	67.00	.055	219
Manchester	56,000	439	2,000	All—every night	4,000	6.00	115.00	.029	695
Nashua	19,311	205	1,200	All—every night	4,000	4.15	112.00	.028	428
Newport	3,000	20	1,200	10:30	2,000	W. P.	50.00	.025	480
North Berwick	2,000	12	1,200	Moonlight-midnight	1,220	W. P.	67.00	.055	219
				All night	4,000	W. P.	87.00	.022	551
Portsmouth	12,000	103	1,200	All night	4,000	3.75	112.50	.028	427
Rochester	8,000	90	1,200	Moonlight-midnight	1,220	W. P.	67.00	.055	219
				All night	4,000	W. P.	87.00	.022	551
Somersworth	7,000	70	1,200	Moonlight-midnight	1,220	W. P.	67.00	.055	219
				All night	4,000	W. P.	87.00	.022	551
				Average	2,757	$ 4.51	$ 80.66	.035	466

NEW JERSEY.

Asbury Park	3,800	75	1,200	All night, 4 months	2,810	$ 2.40	$ 72.00	.056	468
				1 a. m., 8 months					
Atlantic City	20,000	104	2,000	All—every night	4,000	3.50	127.75	.032	626
Bridgetown	13,500	70	1,200	Moonlight	2,852	3.40	81.00	.028	422
Camden	65,000	406	2,000	All night	3,835	2.70	138.00	.036	673
Elizabeth.*	45,000	100	1,200	All night	4,000	2.80	100.00	.025	480
Hoboken	85,000	490	2,000	All night	4,000	2.50	138.00	.035	580
Jersey City	185,000	1,075	2,000	All night	4,000	2.50	99.00	.025	808
Long Branch	10,000	70	2,000	8 months					
		110	2,000	4 months, 7 hours	2,555	3.30	100.00	.046	510
Morristown	11,000	16	1,200	All—every night	4,000	2.25	115.00	.029	417
Newark	225,000	1,565	2,000	All night	4,000	1.70	98.55	.025	811
Passaic	20,000	123	2,000	All—every night	4,000	3.00	110.00	.028	727
Paterson	100,000	645	2,000	All night	4,000	2.25	130.00	.033	615
Perth Amboy	16,000	89	2,000	All night	4,000	3.00	87.60	.022	913
Trenton	60,000	301	2,000	All night	4,000	2.63	98.50	.025	812
Woodbury	4,000	43	1,200	Moonlight	2,179	2.65	85.00	.039	307
				Average	3,615	$ 2.71	$ 105.36	.032	611

ARC LIGHTING STATISTICS.—Continued.

LOCATION.	Population.	Number of Lamps.	Candle Power.	SCHEDULE.	Hours per Year.	Coal per Ton.	Contract Price per Lamp, per Year.	Cost per Lamp per Hour.	CandlePow. per Hour for 1 Cent.
NEW MEXICO.									
Albuquerque	10,000	12	2,000	Midnight	1,825	4.75	139.00	.076	262
East Las Vegas	3,500	17	2,000	All night	4,000	4.25	132 00	.033	606
Raton	3,077	12	2,000	All night	4,000	2.75	99.00	.025	808
				Average	3,275	$ 3.92	$ 123.33	.045	559
NEW YORK.									
Albany	97,121	650	2,000	All—every night	4,000	$ 4.00	$ 124.00	.031	645
Alexandria Bay	1,500	15	1,200	Moonlight	2,179	2.65	66.67	.031	392
Amsterdam	20,000	138	1,200	All—every night	4,000	2.50	98.00	.025	490
Buffalo	389,138	2,500	2,000	All night	4,000	2.00	100.00	.025	800
Canastota	3,000	42	2,000	Moonlight	2,179	2.25	72.00	.033	604
Canton	2,500	29	1,200	Moonlight	2,179	Wood	55.00	.025	475
Cohoes	24,000	141	2,000	All night	4,000	....	108.00	.027	740
Corning	13,000	73	2,000	All night	4,000	2.75	100.00	.025	800
Dansville	5,000	43	1,200	Moonlight	2,179	3.00	63.00	.029	415
Elmira	40,000	210	1,200	All—every night	4,000	....	102.20	.026	470
Ft. Plain	3,000	37	1,200	Moonlight	2,179	2.40	54.32	.025	482
Fulton	5,000	40	2,000	Midnight	1,825	W. P.	60.00	.033	608
Hoosick Falls	6,000	63	1,200	Dark nights to 1 o'clock	1,980	W. P.	60.00	.031	396
Johnstown	10,000	80	1,200	All night	4 000	5.50	100.00	.025	480
Jordan	1.300	17	1,200	Midnight	1,825	W. P.	50.00	.027	438
Kingston	22,000	88	1,200	All night	4,000	4 25	95.00	.024	505
Little Falls	11,000	100	2,000	All night	4,000	4.75	100.00	.025	800
Lyons	4,500	61	1,200	Moonlight	2,179	W. P.	60.00	.028	437

Newburg	25,000	137	1,200	All—every night	4,000	$ 2.25	$ 64.00	.016	750
Oswego	25,000	213	2,000	All night	4,000	W. P.	81.00	.02	987
Owego	6,800	71	1,200	All night	4,000	W. P.	72.00	.018	667
Perry	2,000	36	1,200	Moonlight	2,179	2.00	52.00	.024	504
Phoenix	1,800	27	1,200	All night	4,000	W. P.	45.00	.011	1,068
Poughkeepsie	25,000	256	2,000	All—every night	4,000	3.18	113.00	.028	707
Rochester	160,000	2,248	2,000	All night	4,000	W. P.	91.25	.023	877
Sandy Hill	3,500	43	2,000	Moonlight	2,179	W. P.	84.00	.039	518
Schenectady	23,000	160	2,000	All—every night	4,000	....	116.80	.029	685
Seneca Falls	7,000	77	2,000	12:30 o'clock	2,000	W. P.	65.00	.033	616
Tarrytown	4,000	80	1,200	22 nights to 3 o'clock	2,112	3.25	75.00	.036	338
Troy	65,000	400	2,000	All night	4,000	2.50	66.00	.017	1,210
Watertown	20,000	165	2,000	26 nights per month	3,430	W. P.	82.12	.024	835
White Plains	8,000	60	1,200	All night	4,000	3.65	120.00	.03	400
Yonkers	40,000	265	1,200	All—every night	4,000	3.00	109.50	.027	438
				Average	3,230	$ 3.14	$ 81.96	.026	624

NORTH CAROLINA.

Asheville	15,000	94	2,000	All night	4,000	$ 2.60	$ 96.00	.024	833
Charlotte	21,000	112	1,200	All night	4,000	3.00	90.00	.023	534
Greenboro	10,000	64	1,200	All dark hours	3,680	3.60	87.50	.024	505
Henderson	5,000	22	1,200	Moonlight	2,179	4.00	104.00	.048	252
Statesville	3,000	30	1,200	All night	4,000	Wood.	100.00	.025	480
				Average	3,572	$ 3.30	$ 95.50	.029	521

NORTH DAKOTA.

Fargo	12,000	53	2,000	All night	4,000	$ 6.35	$ 120.00	.03	666

ARC LIGHTING STATISTICS.—Continued.

LOCATION.	Population.	Number of Lamps.	Candle Power.	SCHEDULE.	Hours per Year.	Coal per Ton.	Contract Price per Lamp, per Year.	Cost per Lamp per Hour.	CandlePow. per Hour for 1 Cent.
OHIO.									
Akron	36,000	268	2,000	All dark hours	3,680	$ 1.05	$ 88.00	.024	836
Athens	4,000	35	1,200	All night	4,000	....	72.50	.018	662
Barberton	3,500	45	2,000	Moonlight	2,179	2.00	72.00	.033	604
Bellaire	10,000	70	2,000	All night	4,000	3.50	85.00	.021	942
Canton	38,000	155	2,000	Moonlight	2,179	1.55	62.50	.029	696
....	....	45	2,000	All night	4,000	1.55	87.50	.022	914
Chillicothe	15,000	162	1,200	All night	4,000	2.00	75.00	.019	640
Circleville	8,000	116	1,200	Moonlight	2,179	.75	75.00	.034	350
Cleveland	265,000	400	2,000	All night	4,000	1.25	94.80	.024	843
Dayton	80,000	238	2,000	All night	4,000	....	100.00	.025	800
Delphos	5,500	47	2,000	All dark hours	3,680	2.10	90.00	.025	818
Elyria	10,000	68	2,000	Midnight	1,825	1.40	75.00	.041	486
Findlay	22,500	179	2,000	All night	4,000	1.78	69.50	.019	1,151
Galion	9,000	92	2,000	Dark nights	3,680	1.76	72.00	.02	1,021
Lancaster	10,000	80	2,000	All—every night	4,000	1.70	85.00	.021	941
Marion	12,000	122	2,000	All night	4,000	2.00	83.00	.021	965
Nelsonville	5,000	34	1,200	All night	4,000	.40	60.00	.015	800
New Philadelphia	5,673	75	2,000	All night	4,000	1 00	75.00	.019	1,068
No. Baltimore	4,000	40	2,000	All night	4,000	2.00	85.00	.021	940
Pomeroy	5,500	27	2,000	Moonlight	2,179	.87	89.00	.041	488
Ravena	4,000	43	2,000	All dark hours	3,680	1.35	72.50	.02	1,015
....	....	7	2,000	All dark hours	3,680	1 35	75.00	.02	980
Shawnee	3,500	25	1,200	All night	4,000	.60	70.00	.018	686
Springfield	37,500	225	2,000	All—every night	4,000	2.40	89.00	.022	900
Steubenville	15,000	179	2,000	All night	4,000	1.50	75 00	.019	1,068
Toledo	125,000	700	2,000	All night	4,000	2 00	90.00	.023	890
Troy	6,000	72	1,200	Moonlight	2,179	2.25	90.00	.041	292
Upper Sandusky	3,600	45	2,000	20 nights to 2 o'clock	1,680	1.63	75.00	.045	448
Zanesville	30,000	215	2,000	Moonlight	2,179	1.50	75.00	.035	580
				Average	3.413	$ 1.56	$ 79.56	.025	787

OREGON.

Astoria	8,000	40	2,000	All night	4,000	Wood.	$ 132.00	.033	608
Eugene	4,200	25	2,000	All night	4,000	W. P.	108.00	.027	740
Le Grand	2,500	6	1,200	Midnight	1,825	Wood.	75 00	.041	292
Pendleton	4,000	16	2,000	All night	4,000	Wood.	192.00	.048	416
Portland	81,000	655	2,000	All night	4,000	W. P.	103.20	.026	774
Rosebury	3,000	11	2,000	All—every night	4,000	....	'163.56	.041	488
Salem	12,000	45	2,000	All night	4,000	....	120.00	.03	666
				Average	3,689	....	$ 127.68	.035	569

PENNSYLVANIA.

Allegheny	125,000	1,037	2,000	All night	4,000	$ .95	$ 74.31	.019	1,078
Allentown	33,000	127	2,000	All night	4,000	2.60	100.00	.025	800
Altoona	35,000	200	2,000	All night	4,000	1.25	84.00	.021	952
Ashland	7,800	26	2,000	All—every night	4,000	1.00	115.00	.029	695
Bloomsburg	7,300	60	2,000	All night	4,000	1.00	80.00	.02	1,000
Braddock	13,000	98	2,000	All—every night	4,000	.70	70.00	.018	1,141
Bradford	18,000	100	2,000	All night	4,000	Gas.	75.00	.019	1,068
Butler	10,000	50	2,000	All night	4,000	Gas.	90.00	.023	890
Carlisle	10,000	65	2,000	All—every night	4,000	2.50	90.00	.023	890
Chester	35,000	140	1,200	All—every night	4,000	2.00	84.00	.021	571
Coatesville	5,000	39	2,000	All night	4,000	2.25	93.33	.023	858
Easton	20,000	141	2,000	All—every night	4,000	3.00	79.47	.02	1,007
Erie	55,000	353	2,000	All night	4,000	....	91.25	.023	877
Frackville	35,000	11	2,000	All night	4,000	2.60	100.00	.025	800
Franklin	8,000	91	12,00	10 hours per night	3,650	1.25	55.55	.016	788
Germantown	70,000	219	2,000	All night	4,000	1.85	135.00	.034	592
Homestead	10,000	60	2,000	All night	4,000	1.10	75.00	.019	1,068
Huntington	6,000	51	2,000	Midnight	1,825	1.50	60.00	.033	609
Indiana	4,000	53	1,200	All night	4,000	1.10	60.00	.015	800
Irwin	3,000	25	2,000	All night	4,000	.60	80.00	.02	1,000
Lancaster	40,000	250	2,000	All—every night	4,000	....	70.00	.018	1,141
Lebanon	18,000	80	2,000	All night	4,000	1.95	104.00	.026	770
Lock Haven	7,500	70	2,000	All night	4,000	1.60	73.00	.018	1,095
McKeesport	36,000	185	2,000	All night	4,000	1.05	75.00	.019	1,068
Milton	6,000	50	2,000	All night	4,000	1.80	72.00	.018	1,110
Mt. Carmel	12,000	40	2,000	All night dark nights	3,680	1.50	100.00	.027	735
Norriston	25,000	100	2,000	All night	4,000	2.90	100.00	.025	800
Pittsburg	288,692	1,900	2,000	All—every night	4,000	1.01	96.00	.024	833
Pottsville	16,000	122	2,000	All—every night	4,000	.61	84.00	.021	952

ARC LIGHTING STATISTICS.—Continued.

LOCATION.	Population.	Number of Lamps.	Candle Power.	SCHEDULE.	Hours per Year.	Coal per Ton.	Contract Price per Lamp, per Year.	Cost per 1 amp per Hour.	CandlePow. per Hour for 1 Cent.
				PENNSYLVANIA—Continued.					
Reading	84,000	400	2,000	All—every night	4,000	$ 1.60	$ 105.00	.026	762
Scranton	105,000	527	2,000	All—every night	4,000	.50	91.25	.023	877
Shamokin	20,000	69	2,000	All night	4,000	1.25	90.00	.023	890
Shenandoah	18,000	43	2,000	All night	4,000	1.25	108.00	.027	740
Tyrone	7,000	58	2,000	All night	4,000	1.30	75.00	.019	1,068
West Chester	9,500	71	2,000	All night	4,000	2.60	90.00	.023	890
Wilkensburg	10,000	63	2,000	All night	4,000	.55	80.00	.02	1,000
York	32,000	217	2,000	All night	4,000	1.95	82.12	.02	972
				Average	3,925	$ 1.54	$ 86.14	.022	870
				RHODE ISLAND.					
Providence	154,000	1,800	2,000	All night	4,000	....	$ 127.75	.032	626
Westerly	7,600	26	1,200	Midnight	1,825	$ 3.85	75.00	.041	292
				Average	2,913	$ 3.85	$ 101.38	.037	459
				SOUTH CAROLINA.					
Charleston	64,000	113	1,200	Moonlight	2,179	$ 2.65	$ 100.00	.064	762
Columbia	20,000	139	1,200	All night	4,000	W. P.	65.00	.016	740
				Average	3,089	$ 2.65	$ 82.50	.031	501
				SOUTH DAKOTA.					
Aberdeen	4,500	20	2,000	All night except moonlight	3,680	$ 5.50	$ 125.00	.034	590

TENNESSEE.

Chattanooga.	29,000	200	2,000	All night....................	4,000	$ 1.05	$ 87.00	.022	920
Columbia	6,385	40	1,200	All night....................	4,000	2.50	85.00	.021	565
Johnson City.........	4,000	28	1,200	All night....................	4,000	3.00	92.00	.023	522
Memphis	104,229	250	2,000	All night....................	4,000	1.75	85.00	.021	941
Nashville	90,000	348	2,000	All—every night	4,000	....	91.25	.023	877
				Average.................	4,000	$ 2.08	$ 88.05	.022	765

TEXAS.

Paris	150,000	60	2,000	All night....................	4,000	$ 2.00	$ 100.00	.025	800
....	....	20	2,000	All night....................	4,000	2.00	96.00	.024	833
San Antonio.........	60,000	250	2,000	Moonlight....................	2,179	....	127.75	.059	341
Texarkana	7,000	4	2,000	All night....................	4,000	5.50	120.00	.03	666
				Average.................	3,545	$ 3.16	$ 110.93	.035	660

UTAH.

Logan	6,000	25	1,200	All night....................	4,000	W. P.	$ 45.60	.011	1,050
Ogden	17,000	75	2,000	All night....................	4,000	$ 2.50	108.00	.027	740
Provo................	6,200	17	....	Moonlight....................	2,179	....	74.00	.034	588
Salt Lake City.......	50,000	4,000	2,000	All night....................	4,000	2.75	72.00	.018	1,110
				Average.................	3,545	$ 2.63	$ 74.90	.023	872

VERMONT.

Brattleboro	6,500	44	....	Moonlight....................	2,179	....	$ 90.00	.041	890
....	....	6	....	All night....................	4,000	$ 4.00	150.00	.038	533
Middlebury.........	1,800	24	2,000	All dark nights-midnight.....	1,650	W. P.	52.00	.032	635
St. Albans...........	6,500	59	2,000	21 nights-midnight...........	1,260	4.10	73.00	.058	346
St. Johnsbury.......	8,000	63	2,000	Moonlight....................	2,179	5.00	58.34	.027	746
				Average.................	2,254	4.37	84.67	.039	630

VIRGINIA.

Fredericksburg......	6,000	45	1,200	Moonlight....................	2,179	W. P.	$ 60.00	.028	437
Hampton	5,000	21	1,200	All night....................	4,000	$ 2.85	80.00	.02	600
Newport News......	12,000	42	1,200	All night....................	4,000	3.00	96.00	.024	500
Norfolk	50,000	257	1,200	All night, ex. 3 nights........	3,680	3.55	90.00	.027	490
Petersburg..........	25,000	178	1,200	All night....................	4,000	3.60	60.60	.015	792
Richmond	96,000	516	1,200	All night....................	4,000	2.65	58.40	.015	822
Roanoke............	20,000	130	2,000	All night....................	4,000	2.75	87.60	.022	914
				Average.................	3,694	3.07	$ 76.00	.022	651

ARC LIGHTING STATISTICS—Continued.

LOCATION.	Population.	Number of Lamps.	Candle Power.	SCHEDULE.	Hours per Year.	Coal per Ton.	Contract Price per Lamp, per Year.	Cost per Lamp per Hour.	CandlePow. per Hour for 1 Cent.
				WASHINGTON.					
Anacortes	1,500	29	2,000	All night	4,000	Wood.	$ 144.00	.036	555
Colfax	2,500	6	1,200	Moonlight	2,179	Wood.	120.00	.055	218
Fairhaven	2,000	1	2,000	All night	4,000	$ 4.00	144.00	.036	555
North Yakima	4,000	8	2,000	All night	4,000	3.00	124.80	.031	640
Walla Walla	6,000	47	1,600	All night	4,000	W. P.	120.00	.03	533
				Average	3,636	$ 3.60	150.56	.037	500
				WEST VIRGINIA.					
Charleston	13,000	81	1,200	Moonlight	2,179	$ .90	$ 72.00	.033	363
				WISCONSIN.					
Appleton	15,000	139	1,600	All dark nights	3,680	W. P.	$ 50.00	.014	1,178
Eau Claire	20,000	82	2,000	All night	4,000	$ 6.00	75.00	.019	1,066
La Crosse	30,000	213	2,000	All dark nights	3,680	Wood.	85.00	.023	815
Monroe	4,000	60	1,200	Moonlight-midnight	1,220	2.70	72.00	.059	203
Oconomowoc	3,175	39	2,000	2 a. m. except moonlight	1,890	2.50	96.00	.051	394
Oshkosh	28,000	260	1,200	All night, except moonlight	3,680	3.25	68.00	.019	640
Sheboygan	22,100	128	2,000	All night	4,000	3.50	95.00	.024	842
Superior	30,000	231	2,000	All—every night	4,000	2.20	146.00	.037	548
Waukesha	8,000	67	2,000	3 o'clock	2,920	1.50	78.00	.027	749
Wausau	21,000	80	2,000	All night	4,000	Wood.	80.00	.02	1,000
				Average	3,307	$ 3.09	$ 84.50	.029	744
Green River	1,200	4	1,800	Moonlight	2,179	$ 1.00	$ 180.00	.082	208
....	....	6	1,800	All night	4,000	....	....	.045	400
Sheridan	2,500	16	1,200	All night	4,000	1.75	156.00	.039	308
				Average	3,393	$ 1.38	$ 168.00	.055	305
FORTY-SIX STATES				TOTAL AVERAGE	3,280	$ 3.14	$ 101.48	.034	564

THE PRESIDENT: I understand, Mr. Cabot has a paper on "Ideal House-Top Construction."

Mr. Cabot here read the following paper:

AN IDEAL SYSTEM OF HOUSE-TOP CONSTRUCTION.

J. A. CABOT, CITY ELECTRICIAN, CINCINNATI, OHIO.

Wires that are now strung over or supported on house tops and used for transmitting electricity for various purposes are a nuisance and a menace to life and property. All that can possibly be removed and placed underground should be. The present practice of housetop construction is to place them anywhere, be it on a cornice, skylight or chimney, just so they can be supported and used for the purposes intended. These wires are placed on a man's property regardless of his convenience or safety, and in ninety-nine cases out of one hundred they are put there without his consent. It frequently hapens that when the roof of the building needs repairing the person employed to do the work reports that on account of the number of wires it is impossible to accomplish his task. The owner of the building then wonders how and when these wires were placed there, and if there is any redress. The municipal authorities are compelled to force the companies to remove the wires, the result being that the companies or individuals concerned complain that they are hampered. If property owners would not allow the indiscriminate stringing of wires on the roofs of their buildings, this class of work would then be much safer and more sightly.

The Board of Administration of the city of Cincinnati has restricted, as far as possible, the indiscriminate stringing of electric conductors over housetops, and attempted to get some order out of this chaos; they have constructed an ordinance providing for the tagging of all wires of this class, the filing of plats showing their relative position, and the number of the building to which they are attached. Since the enforcement of this ordinance, the Electrical Department has found over eighty-five miles of dead and abandoned wire, and removed it. All wires now in use in our city are tagged and platted, so that in case they are abandoned by any individual or company the city can compel the former owners to remove them.

MR. STAINSBY: Will you explain the "tagging of the wire"—do they put a tag on the wire?

MR. CABOT: Yes, they put a tag on the wire, right at the cross-arm.

Mr. Stainsby: As they go on the house?

Mr. Cabot: Yes, as they go on the house, so you can trace them out.

Mr. Cabot, continuing, read:

A more dangerous article than an old dead or abandoned wire does not exist; not dangerous in itself, but on account of its great liability to fall on an electric light or power wire, thus cutting through the insulation of the latter, and conducting current to the roof, burning through and thereby setting fire to the building.

Then, again, there is nothing so unsightly as the present construction on the front of a building; pass through any city in the United States, one can see wire straggling from roof to first floor fastened by unsightly, cumbersome brackets and green glass insulators, or, what is worse, knobs held by spikes driven in the mortar between the bricks. It frequently happens a man will paint this building, and a month or two later the tenant orders out his call box or telephone; the company will then instruct the lineman to remove the wires and fixtures, which is usually done in such a manner that the building is defaced and scarred.

All the municipal authorities can do in our State is to designate the manner in which wires are strung. The companies should be required to put up substantial and sightly fixtures, string their wires in parallel straight lines where they cross the thoroughfares. I have not the slightest doubt that such a regulation would be hailed with entire satisfaction by property owners, municipal fire departments, and last, but not least, insurance companies in every city.

In Cincinnati we are still far from perfect in the matter of housetop construction. Anyone conversant in the matter can readily appreciate the fact that all wires cannot be placed underground; telephone service, messenger, cab calls, and signal wires that run into almost every building in a square will never, and can never be buried, but when the telegraph companies finish all of their conduits, and shall have transferred all of their long lines to said conduits, we will recommend the adoption of the system that will now be presented.

Figure 1 shows a main fixture consisting of two panels.

The entire structure is composed of steam pipe and fittings; these fittings are standard, and can be readily purchased at any steam fitter's establishment.

The panels may be more in number, or only one, as may be required.

The drawing shows but one of the many positions in which it may practically be placed. It is now ready to receive wires from two principal directions; the panels are placed at a horizontal angle of ninety degrees with each other.

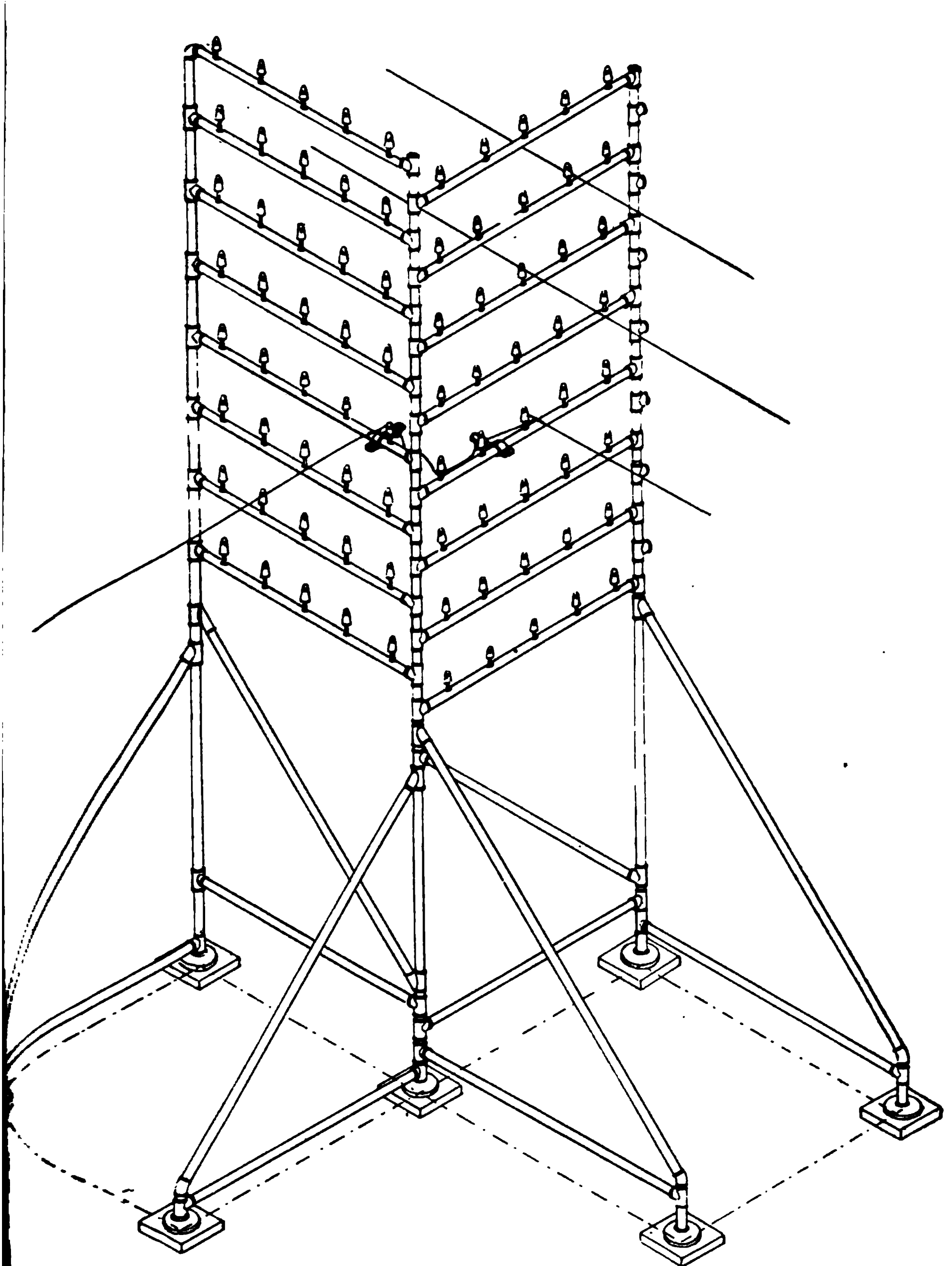


Fig. 1.

This angle is not fixed, however, and may be altered at will; as may also the horizontal angle of the knee brace.

These knees may be turned into such position as will best react to the resultant of the pull of all wires.

The turning of the panels, or knees, is accomplished at any time, either after or before erection, the turning of the pipe threads in the fittings allowing this without trouble; when in position to best meet the pull of all wires the fixture is guyed at the base, and the feet of the knees secured from shifting by guys between them.

Each panel is here shown as consisting of eight cross-arms.

This number may be increased or diminished at any time. By the use of "Tees," with a left-hand thread on the top opening, a cross-arm may be readily detached, or another added, until the limit of the strength of the pipe has been reached.

On the right-hand end of the fixture it will be noticed that additional fittings are inserted in the post, so that another panel may be added at will. These features make the capacity of the fixture entirely flexible.

The fixture may be coated inside and out with asphalt paint and all openings plugged, thereby excluding all air and moisture. With proper care in building and maintaining, it should last indefinitely.

The system of bracing I consider perfect; in connection with the guys at the top it can be made sufficiently rigid to support the strain of from two to three hundred wires.

The standard W. U. steel pins are used inserted in a hole drilled entirely through the pipe and fastened by a nut.

To prevent the cross-arm from turning in its fittings, a hole is drilled with the fitting, through one side of the threaded opening. Then when the cross-arm is in place this hole is continued through the pipe with a breast-drill and a spring cotter inserted, and holds the arm from turning.

The capacity of this fixture, arranged as shown, is eighty wires, spaced twelve inches apart horizontally and eighteen inches vertically, and is designed for those wires which cannot be placed underground and which are not readily cabled.

All wires at the lowest point of sag will be seven feet from the roof, thereby allowing ample space for a man to walk freely beneath; if thoroughly grounded will be an extremely good lightning conductor.

Some people may advance the opinion that an iron fixture is not desirable on account of its being grounded, but as the fixture was not designed for electric light wires (all such wires can be placed underground), but for wires that will never and can never be placed underground, this objection cannot hold good.

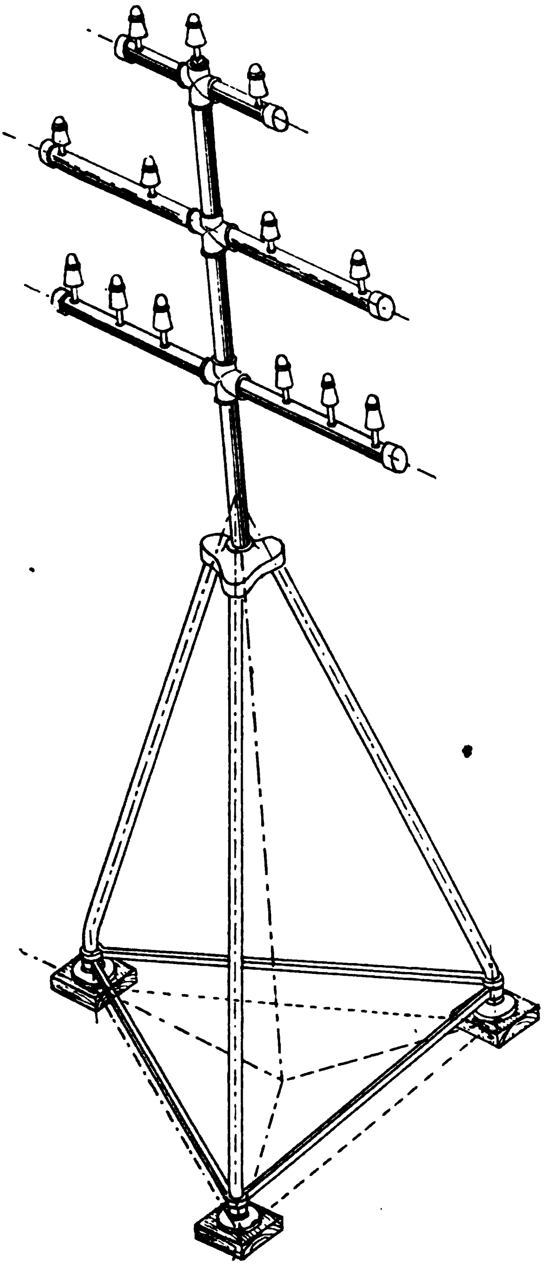


Fig. 2.

On the fourth cross-aim from the bottom it can readily be s how and in what manner wires that are run at right angles to each ot are connected together.

On the second cross-arm from the top can be seen the wires r ning in the same direction.

This fixture is supported by wooden blocks, fastened to the be of the roof and securely guyed to the four corners of the buildi making it extremely secure and rigid.

Figure 2 shows a tripod built on the same lines as the forego fixture, and is intended to accommodate a few wires which must necessity be run at right angles to the main or trunk lines of system, to reach subscribers.

Figure 3 shows the construction of and the manner a ser wire bracket is fastened to the rear cornices of a roof. A tightly fit piece of timber is laid in the gutter-way, and to it is bolted another p of timber laid at right angles; no bolts, nails or screws are dri through the weather boarding or covering of the roof, thereby secu absolute protection from the weather. Also the flow of storm-wate the gutter is not obstructed.

Also a fire wall bracket for nine service lines. It can be buil accommodate any number of wires depending on the length of the v and the number of arms that may be desired, one above the other.

THE PRESIDENT: Gentlemen, do you desire to ask questions pertaining to these papers?

MR. STAINSBY: Have you any of those blue-prints?

MR. CABOT: Only this set here. Here is a tracing sh ing the isometric view of the housetops. Here are so photographs showing the actual condition of the overhead wi in Cincinnati.

MR. ROSEWATER: Do I understand these wires are not electric circuits—not electric wires?

MR. CABOT: No, sir.

MR. ROSEWATER: Just for telephone?

MR. CABOT: The electric wires go underground.

MR. ROSEWATER: Have you figured the weight of t appliance?

MR. CABOT: No, sir, I hav'n't figured the weight at all; it is drawn to a scale.

MR. CABOT: There is no mechanical objection to placing wires of this class underground; with telephone service and messenger wires, that go into almost every building in a block, if they were to go underground, it would necessitate a manhole at every house; I doubt very much whether the municipal authorities would allow a 12-inch plate on the sidewalk or street in front of every building.

CAPT. BEACH: In Washington, on the principal streets, all the wires are underground, and they have these manholes right in the pavement, in front of nearly all the principal stores, and on the principal residence streets also; they are not at all objectionable; there has been no objection made to them.

MR. CABOT: The authorities in England and New York, two or three years ago, tried to force this class of wire underground, but they did not accomplish it; they still remain overhead, on housetops.

MEMBER: What kind of wires, telegraph?

MR. CABOT: No, sir, telephone service, messenger, and cab call wires. Telegraph mains are underground.

MR. ROSEWATER: Those are not underground, in Washington, are they?

CAPT. BEACH: On the principal streets, they are.

MR. ROSEWATER: At one time the Western Union Telegraph Co. proposed to put their wires outside of the city of Washington and abandon the city if they were compelled to go underground. They maintained that they operated multiplex and duplex systems which would not operate underground. I wrote a letter to Mr. Price, the chief electrician of Great Britain, asking how they operated wires of the multiplex and duplex systems, and, to my surprise, he replied, "We have had 25,000 miles of wires operating in England; the multiplex and duplex systems operate better underground than overhead," and the

Western Union people intimated to me that if they had conceded in the case of Washington, they would be compelled to put their wires all over the country underground, and it was political influence that was used to prevent the enforcement of that rule. The electric wires were brought under ground in this way: the electric companies made a report claiming that it was absolutely impracticable, from prior experience, to place electric wires underground, but the District of Columbia Commissioners adopted a schedule of rates—one rate for light that came from overhead wires, and another light from underground wires. They fixed the rate so high for electric light underground that the companies discovered that it was absolutely practicable, and when they met the commissioners, they said, they had found it was a mistake, and would work very well. The fact was, before the commissioners could make a report to the effect that the sub-ways should be the property of the District of Columbia, they had their sub-ways completed, and they made money enough under that five year contract to build the sub-ways out of the difference in the cost, so that they have the sub-ways practically built by the District of Columbia, and practically the government, and that is the way they got their wires underground.

Capt. Beach: There are a great number of wires underground and there are also quite a number overhead. The matter now is hung up pending further congressional action. The matter is in this shape now; that the companies cannot string any overhead wires, and they cannot lay any underground conduits.

Mr. Rosewater: You mean the telegraph company? In fact, there are several.

Capt. Beach: One party couldn't get a wire from his house to only three doors down the street; nobody is allowed to string any wires, and they can't lay any more conduits, so that the extension of electric lighting and telephone and private lighting service is entirely stopped in Washington, until they have further legislation.

Mr. Rosewater: Are they waiting until the district own the plants, or not?

Capt. Beach: That is a matter that congress can decide, what the outcome will be; of course, there are quite a number of features in the case—a number of different factors pulling different ways, so that the outcome is rather problematical.

Mr. Rosewater: The telephone companies are almost all underground, anyway?

Capt. Beach: Almost entirely underground, except in some out of the way districts; the matter is simply tied up. I spoke first in regard to Mr. Cabot's objection to man-holes—that has not been found objectionable in Washington.

Mr. Rosewater: Do you distribute the lines over public poles, that is, when you connect from the underground wires to the houses, or run underground to the house, the same as water or sewer connection?

Capt. Beach: Underground.

Mr. Lewis, of Brooklyn, here read a paper as follows:

SOME OBSERVATIONS ON GENERAL TAXATION AND SPECIAL ASSESSMENTS.

BY NELSON P. LEWIS, ENGINEER STREET COMMISSION, BROOKLYN, N. Y.

The conduct of the affairs of cities is a matter of business, and the amount of money which a city can afford to spend should be determined by the application of business principles.

The sum required to administer its affairs, and to make the improvements needed to render it comfortable, healthful and attractive as a place of abode, to foster its business prosperity, and to attract others to it for business or residence, is large, and the extent to which expenditure for such purposes are wise can be determined by answering a most commonplace question: "Will it pay?"

It may be taken for granted that for a city which has any excuse for continued existence any amounts which may be expended for an abundant and wholesome water supply, for thorough sanitary drainage, and for well-paved, well-cleaned, and well-lighted streets, will prove a wise investment at any cost, so long as the work is skillfully done, according to well-considered plans prepared by competent engineers. If a city has reached the dignity of a metropolis, expenditures on a more generous scale, designed to beautify and contribute to the enjoyment of residents of all classes, such as the purchase and improvement of parks, the ornamentation of streets and squares by fountains and monuments, the erection of public baths, the purchase and demolition of buildings in congested and squalid sections, in order that the denizens of the slums may have before them object lessons in decent living, and, above all, the most liberal expenditures for schools, will be sure to bring a large return for the investment.

In European cities under monarchical governments such improvements were formerly carried out, if done at all, by the crown, and paid for by the state; paid for, it is true, out of money wrung from its subjects by oppression and excessive taxation. In a modified form such methods are followed in Europe to-day, especially on the continent, and they have one great advantage—a new king does not take office every year or two and try to improve upon his predecessor's administration by tearing down what he has begun and starting on a new plan.

It is said that the second Napoleon once expressed a wish that he could see the opera house from the Tuilleries. A broad street was immediately cut through the intervening blocks for more than a mile, and the superb Avenue de l'Opera was the result.

We can imagine the indignant protests which would arise at a similar proposition in one of our large cities if the object were simply to make another beautiful street.

But the question is, where is the money to come from to pay for such improvements as have been mentioned. The first cost is very large, and cannot be paid for as a direct tax. The municipality must, therefore, incur a debt. This debt is simply an investment, and the advisability of incurring it is determined by one consideration—will it pay?

The American method of paying for improvements which can be considered local in benefit to be derived is entirely different from that followed in Europe. There the municipality bears the whole burden, while here a district of assessment is fixed, and an assessment laid according to benefit.

The exceedingly costly improvements carried through within a few years in London, such as the widening of old, and the cutting through of new streets, and the building of bridges, have been carried out wholly at the expense of the public at large. If property has to be taken it is generously paid for, but not one dollar of special assessment is laid upon the owner of adjacent property which is doubled or trebled in value on account of the improvement. Further extensive improvements in London are now being deferred, it is said, until Parliament shall have authorized a new system of taxation under which a part, at any rate, of the burden shall fall upon the owners of property which is chiefly benefited.

It is the common practice in America to assess the entire cost of all original improvements upon the property benefited thereby, while subsequent renewals are paid for by the municipality. This system will probably explain the fact that many of our cities are laying pavements which can be called only temporary, often unsanitary, and always short lived, because as cheap as possible. In the Eastern States cobblestone and macadam, and in the West poor macadam and wooden blocks have thus been used.

Some restrictions should certainly be placed upon the kind of pavement which can be laid by assessment before the city will become responsible for future renewals. All of the States, probably, have fixed a constitutional limit to the bonded debt of cities, and in many of the Western States this is as low as five per cent. of the assessed value of the real estate.

Some cities are so located as to require no great outlay for an ample system of water supply, and for the proper disposal of sewage. In other cases these items may go far towards bringing the debt up to the constitutional limit. It would seem unwise, therefore, to fix the same limit in all cases. In New York State, where the limit to the bonded debts of cities is ten per cent. of the assessed value of the realty, it is especially provided that this limit can be exceeded in the case of bonds sold for the purposes of water supply, but, having been thus exceeded. no bonds can be issued for any other purpose until such time as the real values shall have expanded sufficiently to bring the total debt again within the ten per cent. limit.

It seems to the writer that the only wise purpose which a five per cent. limit can serve is that it places a check upon unwise, ill-considered or reckless expenditure by incapable public officials. If such expenditures involve heavy special assessments the people so assessed will be heard from, while, if it simply means the piling up of a public debt, they are too apt to be indifferent. Our people do not mind being taxed if they get the full value of their money. Any city of importance is proud of its parks, its public school buildings, its well-paved streets, and fine boulevards, if it is fortunate enough to have them; but in order to obtain them without exceeding the debt limit usually prescribed by law it is necessary to pay for as many of the improvements as can be justly considered to be local in their benefit by laying special assessments upon such property as will derive a benefit therefrom.

It will frequently in the case of extensive improvements be more just for the municipality to assume a certain proportion of the expense and distribute the remainder over a considerable area which will receive a special benefit. If special commissions are selected to lay out such districts and levy such an assessment there is great probability of a lack of uniformity in the treatment of such problems, and it would be preferable to have such functions always performed by a board or department of assessment, which should be a continuous body, the members being selected for long terms overlapping each other, so that a consistent policy will be followed, and the danger of injustice or the imposition of unequal burdens for the benefit received will be minimized.

The new charter for the Greater New York provides for a board of taxes and assessments, consisting of a president and four other persons. The president is to be appointed for a term of six years, and his salary is fixed at $8,000 a year, while his associates are to be appointed for terms of four years, with salaries of $7,000, the term of one member of the board expiring each year.

The mayor is also to appoint a board of five assessors who shall be charged with the duty of making all assessments for local improvements, while the comptroller, corporation counsel, and president of the board of public improvements will constitute a board of revision of assessments, who shall have power to consider all objections made to any such assessments, and to confirm the same or refer them back to the board of assessors for revision and correction in such respects as it may deem proper. The charter prohibits the laying of any assessment amounting to more than one-half of the "fair value" of the property assessed. It is generally held, that after an assessment has once been laid for paving a street, subsequent renewals should be paid for by the city at large, the policy of Buffalo, where all repaving is assessed upon the abutting property, being a conspicuous exception. The new charter for New York prohibits laying an assessment for any portion of the expense of such renewal where the original pavement was laid at the expense of the adjoining property, except upon petition of a majority of the owners of the property (who shall also be the owners of a majority of the front feet).

The customary practice in Brooklyn is to assess according to frontage one-half of the cost of repaving any street whereon an improved pavement has never been laid at the expense of the property owners, the city at large paying the other half. By "improved pavement" I mean a pavement of asphalt, or vitrified brick, or any pavement laid on a concrete foundation, In case the street to be repaved is occupied by a surface railroad, one-fourth of the expense is assessed upon the railroad company, and one-fourth upon the property, the city still bearing one-half.

The railroad companies seem disposed to contest the validity of such an assessment on the ground that they own no realty, which only can be assessed for benefit, while neither their track nor their franchises are thus accessible. It would doubtless be more prudent to fix this obligation of the railroad companies by amending their charters rather than to attempt to assess them for benefit.

A popular plan to obtain relief from assessments for original improvements, especially where on account of heavy grading or rock excavation the first cost is large, is to persuade the city to loan its credit by issuing bonds to meet the expense, and allowing the property benefited to pay for the improvement, including interest on the bonds, in installments. As an instance of this plan some enterprising citizens of one of the outlying wards of Brooklyn secured the enactment of a law requiring the city to issue bonds to the amount of $650,000, which sum was to be expended in opening, sewering, grading and paving the streets in a portion of their ward where the grading was comparatively heavy, involving cuts and fills of a maximum height of perhaps 30 feet.

Upon the completion of the work the cost, including the interest on the bonds, was divided into 20 equal parts, one of which is to be paid each year. The result was very advantageous for this section, and the property had increased in value by several times the total assessment before the first installment was due.

The advocates and beneficiaries of this legislation point to the fact that within six years after these improvements were commenced the assessed value of the realty of this ward had increased nearly $5,000,000, thus raising the borrowing capacity of the city nearly half a million of dollars, or 77 per cent. of the original bond issue, and claim that it has proved to be an admirable investment for the city. This is a hasty judgment. How much of this increase would have occurred without this special aid? The section benefited was in the natural line of development. How much also of the money invested here was diverted from other parts of the city which have been unfairly injured? If the actual increase of the city's wealth, which is due solely to this policy, could be determined, it would certainly be much less than it seems. If a municipality's financial condition is such as to permit it to loan its credit impartially in all sections by advancing a part of the first cost of such original improvements, it might give a noticeable impetus to development, and add to its apparent wealth.

Would it not, however, be a wise policy to limit the expenditure of its reserve to furnishing an abundant and excellent supply of water at a nominal cost, or actually free, and to clean and light its streets more perfectly, or even to purchase and improve more parks.

Nothing stimulates manufacturing more than an assured and abundant supply of good water at low rates. The charge for this is constant, while the special assessment comes only occasionally, and is soon forgotten.

The writer does not contend that the rule should be rigorously enforced of compelling the abutting property to pay the cost of original improvements in all cases. The annexation of new territory sometimes offers great opportunities for development if the section be made easily accessible, but before sewers have been built and water mains laid it would be folly to lay permanent pavements even though the property were able to bear the assessments. In such cases the expense of building a system of good macadamized roads would prove a profitable investment, although, if the charter law would permit it, the expense might more justly be borne wholly by the suburban section to be developed, the municipality loaning its credit by issuing bonds or certificates of indebtedness, to retire which five or ten special annual assessments could be laid upon all the property in any degree benefited.

From this hasty and superficial consideration of the subject a few general conclusions can be drawn.

It is impossible to frame a general rule as to where general taxation should cease, and special assessments be resorted to, which will justly apply to any group or class of cities in any state or section.

For the same reasons, a limit of bonded debt based upon a fixed percentage of realty values cannot give uniform results in different cities.

It is better for cities to make liberal expenditures in those directions which would render them more attractive for residence and business, and which tend to lighten the annual burdens of the tax-payer, than in paying any part of the ccst of original improvements which are essentially for local benefit.

Special legislation authorizing expenditures for the exclusive benefit of certain sections is unfair. If assistance be given for such purposes, it should be done with absolute impartiality as to location.

The fixing of districts of assessment and the apportionment of cost should be done by a permanent board or department, the members of which should serve for long terms, in order that its action may always be consistent. Special commissions for the carrying out of improvements or the laying of assessments for the same are likely to be costly, inefficient and unsatisfactory.

THE PRESIDENT: Gentlemen, at previous meetings it has been the custom to provide for the appointment of a Nominating Committee, to present, for the consideration of the Society, the names of officers to be elected. We should also provide for the appointment of a committee to decide upon the next place of meeting of the Society. If it is the desire of the organization to proceed in the same manner this year, it would be in order now to place in nomination the Nominating Committee. What is the pleasure of the Society?

Mr. Sherrerd, Newark: I move, Mr, President, that we proceed in the usual manner, and that the nominations be in order for the five members of the committee.

For this committee, there were nominated: Mr. Rundlett, of St. Paul; Mr. Stainsby, of Newark; Mr. George H. Frost, of Plainfield, N. J.; Capt. Beach, of Washington; Mr. Benzenberg, of Milwaukee, which nominations were concurred in by the Society.

Mr. Sherrerd: I move that the Chair appoint the Committee on the next place of meeting.

The motion to have the Chair appoint the committee was passed, and the President appointed the following gentlemen as the Committee on Place of Holding the Next Annual Meeting:

Mr. M. R. Sherrerd, of Newark, N. J.
Mr. Geo. W. Tillson, of Brooklyn, N. Y.
Mr. Andrew Rosewater, of Omaha, Neb.
Mr D. L. Fulton, of Allegheny, Pa.
Mr. H. J. Stanley, of Cincinnati, O.

The President: That is the only business that we have on the programme for this evening. The Committee on Paving will not be ready until to-morrow, I understand.

I want to say, gentlemen, that it is desirable to meet to-morrow morning.

Adjourned until Wednesday morning.

WEDNESDAY, OCTOBER 6th, 1897. MORNIN

The convention was called to order at 9:40 a. m., by dent Herrmann.

THE PRESIDENT: The first order of business for this ing is the report of the Committee on Street Paving.

Mr. A. D. Thompson, of Peoria, Ill., here read the fol report:

PEORIA, ILL., NOV. 24, 18

TO THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS:

Gentlemen: The Committee on Street Paving has directed its during the past year toward the consummation of three objects,

1. To procure papers of interest and value for presentation present meeting.

2. To collect data from all cities of the United States, giv total amounts of the various pavements constructed, and the mil each class, with the cost for each year since 1894.

3. To present explicit specifications defining the condition in an asphalt pavement should be at the end of the guarantee period

A circular letter was forwarded early in the season to each m of the Society directing attention to the next meeting, the imp of street paving, and requesting a paper on the subject which wo forth new ideas or methods. A large number of personal letter also sent to engineers who do not belong to the Society, but w prominently identified with street paving work. It was hoped manner to obtain ideas of value to the members, and also to intere men in the work of the association.

The members of the Society have favorably responded to requests in a most encouraging manner, thus enabling the commi present an exceptionally large number of able papers for consid and discussion.

In compiling data relative to the mileage and cost of pavem the United States, a circular letter was forwarded to the city en of every city in the United States having a population of 10,000 or according to the census of 1890, requesting the mileage laid, and paid for asphalt, brick, granite, wood and sandstone or trap rock, the seasons of 1895, 1896 and 1897, together with the total mileage o

It was desired to have the cost in various sections of the c reduced to a common basis for the purpose of comparison, and th

THE NEW YORK
PUBLIC LIBRARY.

ASTOR, LENOX AND
TILDEN FOUNDATIONS.

was explicitly stated. Yet many engineers failed to comply with the request, and in some instances they furnished figures so evidently wrong as to require revision before tabulation.

Very few of the large cities furnished the data desired, and the entire number of replies were surprisingly small. Letters were sent to 420 cities and but 144, or about 34 per cent., responded. The data thus received is given in detail in Table No. 1 of this report.

Twenty-two of the cities, or about 15 per cent. of those responding, have no pavements. The replies show that in 122 cities of the United States and Canada, having a population of 10,000 or more, there is now laid the following amounts of the several kinds of pavement:

Asphalt	1365 miles.
Brick	705 "
Granite	1151 "
Wood	729 "
Sandstone or Trap	547 "

The figures from these cities also show a marked increase each year in the amount of asphalt and brick pavements laid, and a decrease in the mileage of wood and granite pavements constructed. The mileage laid each year is given in the following table:

TABLE NO. 2.

Showing the amount of paving constructed in 122 cities of the United States and Canada, during the years 1895, 1896, and 1897.

	Miles of Pavement Laid.				
Year	Asphalt	Brick	Granite	Wood	Sandstone or Trap Rock.
1895	102	80	82	22	24
1896	131	106	42	20	11
Per-cent. increase.	28.4	32.5			
Per cent. decrease			48.8	9.1	54.2
1897 to Sept. 1	125	69	14	6	9

The following table gives the percentage of each class of pavement to the total of each year:

TABLE NO. 3.

Showing the percentage of each class of paving to the total laid each year in the above cities.

	Per Cent. of Total.					
Year	Mileage	Asphalt	Brick	Granite	Wood	Sandstone or Trap Rock.
1895	310	32.9	25.8	26.5	7.1	7.7
1896	310	42.3	34.2	13.5	6.5	3.5
1897 to Sept. 1.	223	56.1	30.9	6.3	2.7	4.0

A fair comparison cannot be made of the cost of paving in different cities, because the costs, as given, do not include the same items of expense, although the committee especially requested that the prices given be reduced to a common basis, and should include nothing but the wearing surface and foundation. The prices in any one city include the same items for the various years, and the average cost each year will indicate the general tendency toward an increase or decrease in the prices paid. This comparative cost is given in the following table:

TABLE NO. 4.

Showing the average cost per square yard and the decrease in cost of pavements in 122 cities of the United States and Canada, having a population of 10,000 or more.

Pavement	1895	1896			1897 to Sept. 1st.				
	Av. Cost per Sq. Yd.	Av. Cost per Sq. Yd.	Decr. from 1895		Av. Cost per Sq. Yard	Decr. from 1896		Decr. from 1895	
			Cost per Sq. Yd.	Per Cent.		Cost per Sq. Yd.	Per Cent.	Cost per Sq. Yd.	Per Cent.
Asphalt..	$2.50	$2.33	.17	6.8	$2.08	.25	10.7	.42	16.8
Brick.....	1.72	1.63	.09	5.2	1.56	.07	4.3	.16	9.3
Granite...	2.33	2.32	.01	0.4	2.26	.06	2.6	.07	3.0
Wood....	1.31	1.13	.18	13.7	1.18			.13	9.9
Sandstone or Trap Rock...	2.09	2.07	.02	1.0	1.67	.40	19.3	.42	20.1

Your committee also requested the engineer to state the kinds of asphalt used by their cities, and of the 122 replies tabulated 72, or about 59 per cent., gave this information. Or, of the 420 cities addressed, but a little over 17 per cent. furnished data upon this point. From these replies the following summary of the kinds of asphalt used, has been compiled:

30 cities or 41.7 per cent. use Trinidad Pitch Lake Asphalt only.
5 " " 7.0 " " " Land Asphalt with other kinds.
7 " " 9.7 " " Bermudez Asphalt with other kinds.
9 " " 12.5 " " Alcatraz " " " "
8 " " 11.1 " " Asphalt Block only.
2 " " 2.8 " " Asphaltina only.
8 " " 11.1 " " California Asphalt with other kinds.
3 " " 4.1 " " Utah " " " "

At the last annual meeting of the Society the following resolution was adopted:

"That the Committee on Street Paving be requested to prepare a set of specifications for governing the point 'What Constitutes an Asphalt Pavement in Good Repair, Particularly with Reference to the Condition the Pavement Should Be in at the Expiration of the Guaranty.'"

Your committee has earnestly taken up this question, and have endeavored to formulate definite and satisfactory specifications governing the point under consideration.

The principal features to be considered in examining an asphalt pavement to be placed in condition for acceptance are: 1st, the thickness compared with that of the original; 2d, the extent of disintegration; 3d, depressions or elevations, and 4th, the length, breadth, direction and character of the ruptures.

Heavy traffic and constant sweeping or scraping are the main causes which reduce the wearing surface in thickness. Extended observations and inquiries show that the decrease in thickness of an asphalt pavement after five years of use, is so small as to be of little consequence, even in cases where the amount of traffic has been excessive.

Disintegration, or the separation of the mixture into its various ingredients by the action of the elements, can generally be attributed to the use of poor materials, to an improper mixture, or to neglect in manipulation.

As these features are wholly within the control of the contractor, it is clear that he should be required to renew all places showing the least signs of disintegration.

Settlement of trenches beneath the pavement, shoving of the asphalt by travel, buckling of the concrete foundation, and expansion of the wearing surface, will produce depressions and elevations on the surface of the pavement, which mar the appearance of the street and interfere with the traffic. When due to either of the three last causes they are clearly created by faulty material and workmanship, and the contractor should be required to remedy such defects.

Depressions caused by the settlement of trenches cut into the street before the contract is signed should be made good, as the contract in such cases is taken with a full knowledge of the facts. But a grave injustice is frequently, done the contractor and the pavement by cities arbitrarily cutting deep trenches in the street for the purpose of laying gas, water or sewer mains and services after the contract is signed, or the work of paving has begun. and compelling the contractor to become responsible for such work.

One of the most serious defects of asphalt pavements in certain sections of the United States is the formation of cracks by the contraction of the asphalt during sudden and extreme changes in temperature. These variations in temperature are so extreme in certain localities that it has been impossible with the mixtures now used to prevent rupture of the pavement. without laying the material so soft that it soon forms waves and ridges. which are more detrimental to traffic than the cracks. In localities subject to changes in temperature. sufficiently severe to cause extensive cracking of the pavement, it would appear wise to provide for such contraction and expansion by separating the pavement into separate blocks at stated intervals, in the same manner as is now done on cement walks and curbs. These divisions should be at such intervals along the length of the street that the spaces will allow the mixture to expand without forming ridges, and the contraction will not produce separations sufficiently large to be objectionable.

In considering this question the Chairman of the committee made a personal examination of the condition of pavements composed of the various kinds of asphalt, after having been laid for a period of five years or more, in cities of Chicago, Buffalo, New York, Brooklyn and Washington, and also gave due weight to the condition of the pavements in Cincinnati, Indianapolis, Pittsburg and Philadelphia, which had been previously visited and the asphalt pavements inspected. In the examination the particular points considered, were the decrease in thickness, the formation of rolls and ridges and cracking of the surface. The object sought, was to determine the causes, extent and responsibility of these defects by an inspection of pavements laid with the various kinds of asphalt under different climatic conditions, in order to provide guarantee stipulations that would be general in character and be fair to municipalities and contractors.

Your committee have also consulted with prominent engineers and contractors, and present with this report the views regarding the condition of an asphalt pavement at the end of the guarantee period of Mr. E. B. Guthrie, chief engineer, Buffalo, N. Y.; Mr. E. P. North, consulting engineer to the Department of Public Works, N. Y.; Cranford & Co., paving contractors, New York, and Mr. Phillip W. Henry, of the Barber Asphalt Paving Company.

Your committee does not consider it possible to give definite specifications for this work that will be applicable to all localities, but after a careful consideration of all the facts obtainable, and after due consideration of the opinions presented, we would recommend that the following clauses, modified as found necessary for each locality, be included in the guarantee contracts of the cities belonging to the association.

Section 1: The pavement shall not be reduced more than one-fourth (¼) inch from the original thickness at the end of the first five years, nor more than one-half (½) inch from the original thickness at the end of the first ten years. This requirement shall not apply to pavements constructed of rock asphalt, as this material does not receive its ultimate compression for a considerable period after being laid.

Section 2: Places which show a disintegration of the material shall be removed to the binder or concrete foundation, as found necessary, and replaced with new material having the same thickness and conforming to the adjacent pavement.

Section 3: All elevations or depressions three-eighths of an inch or more, above or below the general surface of the street, shall be brought to the same elevation as the general surface. These elevations and depressions to be determined by measuring from a straight edge four (4) feet in length, placed on the surface of the pavement parallel to the line of curbing. In making such repairs the process known as "skimming" may be employed.

Section 4: Where elevations or depressions are due to the failure of the concrete foundation from any cause, the asphalt and concrete shall both be removed a length and width sufficient to include the entire defect.

If the failure is due to buckling of the concrete, the new foundation shall consist of broken stone thoroughly compacted, and of the same thickness as the original concrete. In all other cases a new foundation of concrete shall be placed of the same quality and thickness as the original construction. Upon the foundation shall be placed the pavement of the same thickness as the adjacent surfaces.

Section 5: Cracks which show any indication of disintegration, or which are three-eighths (3/8) of an inch or more in width, shall be cut out of the binder or concrete foundation as found necessary, a length and width sufficient to include the entire portion affected. This portion to be replaced with new material of the same quality and thickness, as shown in the pavement adjacent thereto.

Section 6: Should it be found necessary to replace forty (40) per cent. or more of any section of the street with new material, the entire section shall be resurfaced.

Your committee would also recommend that the indefinite and unjust requirements that the pavement shall be satisfactory to one officer, or set of officers of the city, at the end of the guarantee period, with no definite requirements of condition, be omitted from guarantee clauses.

Your committee would further recommend that the city engineers of this Society maintain a record of the traffic on the paved streets in their respective cities, in order to determine the most durable pavement and the best pavement suited to specified requirements of traffic.

Respectfully submitted,
A. D. THOMPSON,
Chairman.
N. P. LEWIS.

A. D. Thompson, C. E., Chairman of Committee on Street Pavement, American Society of Municipal Improvements.:

Dear Sir: The laws of the city of New York provide "in case of any street or avenue shall have once been paved and the expense thereof assessed upon the owners of adjoining and benefited property, the cost of repaving shall be borne by a general assessment upon all the taxable property in the city." Under this law it is held that the Department of Public Works cannot make a contract for assessment work covering maintenance, for a longer period than five years. But in all cases of repaving with asphalt, our contracts now provide for a 15 years term of maintenance.

In addition to this the Department of Public Works has lately been letting contracts for the maintenance of those asphalted areas on which the term of maintenance has expired, for a further period of ten years. These contracts are so worded that during the first period of 5 or 15 years, as the case may be, and for a further period of ten years "the surface of the pavement shall be free from cracks, bunches, holes and any depressions that shall measure more than ½ inch from the under side of a straight-edge 4 feet long laid on the surface." It is further provided that repairs shall be made within 48 hours from the date of the service of a written notice to be served on the contractor, either personally or by leaving said notice at his residence or with any of his agents in charge of the work or employes found on the work. And if the contractor shall fail to make repairs within 48 hours from the date of the service of the aforesaid notice, then the said Commissioner of Public Works shall have the right to purchase such material as he shall deem necessary and to employ such person or persons as he may deem proper and to undertake and complete the said repairs and to pay the expense thereof out of any sum of money due the contractor. Or the Commissioner of Public Works may, if he deems it for the public interest, relet the maintenance of the pavement on the specifications of the contract for the unexpired term of the contract, and if the computed cost on such reletting exceeds the cost under this contract and the retained money in the hands of the Comptroller the sureties bind themselves to pay any deficiency. It is provided further that the contractor shall have the right in the case of ditches to provide against settlement by covering the surface of the cut with broken stones and maintaining the surface for six days and during winter weather any hole in the pavement may be filled and maintained with broken stone or asphalt mastic.

In the contracts for laying and maintaining, it is provided that the contractor shall within 48 hours from the receipt of notice, repair all cuts in his pavement made for water or sewer connections or for other purposes allowed by the Commissioner of Public Works, at his contract price per square yard for the new pavement, the contractor assuming all risk of settlement; but, as a matter of fact, if settlement occurs, the plumber or person who opens the pavement is generally forced to recoup the contractor for any expense due to settlement. In case the contractor defaults in his repairs, the Commissioner is authorized to procure material and labor and do the work himself.

In the contracts for repairing and maintaining asphalt pavements, the contractor agrees that during the said period of 10 years, he will restore the pavement over trenches made for laying water and gas pipes, sewers and for other purposes permitted by the Commissioner of Public Works, at the uniform price of $4.00 per square yard; and that wherever the surface of the pavement may be burned out by fire, he will restore it at the rate of $2.00 per square yard and when once so laid and restored maintain the same in the same state of repair as agreed to for other parts of the pavement. He further agrees not to demand additional or further payment on account of injury or sinking of the pavement so laid and restored.

The sureties to all of our asphalt contracts are two Surety Companies to be approved by the Comptroller, the acceptance of individual sureties for long term contracts having proved disastrous. In the asphalt contracts specifying a maintenance of only 5 years, the entire work is paid for at the expiration of 30 days from the acceptance of the work. the recourse for bad work being had against the sureties. On those contracts where a 15 years term of maintenance is specified, 70 per cent. of the entire cost of the work is paid 30 days from the acceptance of the same and no further payment is made until the sixth year, when annual payments of 3 per cent, are commenced and continued till the conclusion of the maintenance contract. In the 10 years contract for repairing and maintaining, the payments are made semi-annually.

At the close of the maintenance contract it is provided that the wearing surface shall not be less than 1½ inches in thickness in any place. The intention of the provisions above cited is to secure a good pavement and its continued maintenance, and, although the provision for repairing, wherever there is a depression exceeding ½ inch under a 4 foot straight-edge, has only been inserted in our contracts since the commencement of 1896, it is thought that the surface of asphalt pavement in the city of New York is freer from cracks, bunches, holes and depressions than is the surface in any European city. At first the asphalt contractors objected to these specifications, but the objections were withdrawn when their attention was called to the fact that they were perfectly understood and, though possibly rigorous, clearly specified the requirements in the case.

EDWARD P. NORTH,
Consulting Engineer, Dept. of Public Works, New York City.

To A. D. Thompson., Chairman of Committee on Street Paving, American Society of Municipal Improvements:

SUGGESTIONS FOR MAINTENANCE GUARANTEE ON ASPHALT PAVEMENTS.

The guarantee should be made for 10 years instead of 5, and the maintenance clause should sead somewhat as follows:

The contractor binds himself to do all the work and furnish all the materials necessary to maintain the pavement during the term for which this bond is given in good condition as to quality and contour whenever and wherever and in the manner directed by the Chief Engineer within five (5) days after written notice to that effect is served upon the contractor. Just prior to the expiration of the term of guaranty the work is to be inspected and all imperfections, depressions, unevenness of surface, alignment and level of curbs on all classes of pavement and on asphalt pavement cracks, rolls, breaking of wearing coat or base or any variations due to settlement exceeding one-half inch from the line of a five (5) foot straight edge or template applied respectively parallel and at right angles to the curb, are to be replaced as the Engineer shall direct, and upon the repairs being made the Engineer will accept the same in writing and until such acceptance the guaranty shall be in force. Any perceptible waviness in surface due to soft material or sliding on concrete. cracks and broken places will be removed to the concrete by the heating process and replaced with new material. The contractor further binds himself to repair the street only on the orders of the Chief Engineer at and just prior to the expiration of guaranty upon the following conditions:

If it be found that in order to maintain and keep the pavement in good repair in any street it is necessary to repair more than 25 per cent. exclusive of settlement of the total yardage in said street, then the contractor agrees to take up the entire surface of the street and replace it by new material; also if any continuous 300 feet of any such street requires repairs to the extent of more than 25 per cent. of the yardage of such 300 feet, then the whole of such 300 feet are to be taken up and replaced by new material, such continuous repairs and yardage to be deducted from the total in the whole street. In case the number of lineal feet of cracks exceeds the proportion of 5 feet of cracks to 1 lineal foot of pavement, then such 300 feet or multiple thereof is to be replaced, regardless of the above percentage of repairs.

In making repairs prior to the expiration of guarantv new material only shall be used. That which has been taken up from any other street will not be allowed.

In the event that the contractor refuses or fails to comply with the orders of the Chief Engineer to make repairs at any time, then the sureties on said bond will be notified and directed to proceed with the repairs as directed by the Chief Engineer.

EDWARD B. GUTHRIE,
Chief Engineer, Buffalo, N. Y.

BROOKLYN, N. Y., OCT. 2, 1897.

MR. N. P. LEWIS, DEPARTMENT OF PUBLIC WORKS, BROOKLYN:

In reply to your request that we should give you our opinion of what should be the condition of an asphalt pavement at the end of 5 years after it has been in use by the public, we have to say, that our experiences of the past 20 years has been confined chiefly to making pavements with the Trinidad Lake asphalt, and we find that such pavements, having an average amount of travel, look as well at the end of five years as they do at the end of two years; slight abrasions may be detected, but they ought not in any case to show more than one quarter of one inch under a four foot straight edge.

It ought to be said, however, that some exceptional streets have an extraordinary amount of travel and traffic and for such the above statement cannot fairly apply. We have one avenue in Brooklyn, Bedford avenue, paved with asphalt, that carries more than 30 times the travel over it of the average streets, and yet even on this avenue the pavement is in good condition at the end of five years.

Yours respectfully,
CRANFORD & CO.

OCTOBER 2, 1897.

NELSON P. LEWIS, TULANE HOTEL, NASHVILLE, TENN.:

Dear Sir: In regard to the specifications for the condition of an asphalt pavement at the end of the guarantee period. I have not had time to give the matter sufficient thought to be willing to express myself officially. However, it is my personal opinion that a suitable specification should call for not less than 75 per cent. of the original thickness of the asphalt, that there should be no cracks greater than ¼ of an inch and not more than one crack to 100 lineal feet of street, that there should be no depressions greater than ½ an inch under a four foot straight edge.

Such a specification, elaborately to some extent, I think, would be fair to the contractor and to the city. We have never given this question any considerable thought as we have had little or no difficulty in getting our streets accepted at the end of the guarantee period.

We have always taken a pride in keeping up our pavements and frequently have done more work upon them at the expiration of the guarantee period than was absolutely necessary.

In these days of low prices, however, the question of the condition of streets at the end of the guarantee period assumes greater importance than it did a few years ago.

I have no doubt that your committee which has this matter under consideration will be able to formulate a specification which will cover the case as fully as any specification can.

Yours truly,

(Signed) PHILIP W. HENRY.

Upon reading of table showing number of cities and the various asphalts used by them, the following discussion took place:

Mr. Thompson: Peoria is located in a district subject to sudden and extreme changes of temperature, and we have found it impossible to lay an asphalt pavement which will not crack.

During the past season I have attempted on one street to prevent such ruptures by separating the asphalt surface down to the concrete, at intervals of fifty (50) feet, from one curb to the other. The asphalt is cut with a trowel while it is being laid, and after the hand-roller has partially compressed the mixture. The small crack thus made is then filled with hydraulic cement, well swept in, after which the surface is compacted by a steam roller, leaving a fine line of separation which is not noticeable to the ordinary observer.

It is believed that when contraction takes place the pavement will not rupture, but will separate at these division points, and that the small places will be sufficiently frequent to take up the expansion and prevent the formation of rolls and ridges. It is simply an experiment and it is impossible to determine the outcome at present. The Barber Asphalt Company claims to have overcome the formation of cracks by using the Pittsburg flux with the asphalt. This flux is not affected by changes in temperature, and about 11 pounds is used with 100 pounds of the refined asphalt, thus preventing any contraction or expansion in the mixture.

MR. STAINSBY, Newark: I want to ask a few questions on that paper. Will you please explain what you mean by the number of cities where only one kind of asphalt is mentioned. Do they exclusively use that brand?

MR. THOMPSON: No, the only cities using exclusively one asphalt are those that use the Trinidad Lake. These other cities allow the use of other asphalts. In all such cases, two or three kinds are used.

MR. STAINSBY: Mr. Chairman: That is the most valuable paper that this Board has had in two years with reference to street paving, and I rise to ask whether, in the compilation of the report, that couldn't be among the first to be sent out to each member of this Society separately by itself, so that we can have the points that are dwelt on there to use immediately, or as soon as it can be printed? I would like to know from the Chairman whether that can be done or not.

THE PRESIDENT: I suppose the convention will authorize the Executive Committee to have the Annual Report printed, who will take official notice of that.

MR. STAINSBY: I think every member here would like to have a copy. I want to compliment the committee on the excellent work they have done. They are certainly entitled to that from this body.

MR. ADAM: I think it would be wise for the committee to recommend to this Society that the members, in giving prices for asphalt pavements in their papers, state a separate price for the excavation, a separate price for concrete, and a separate price for asphalt, such as was done in one of the papers. I think, if we could get that uniformity, it would give us a better opportunity of comparing prices. I know in corresponding with engineers and reading statements in papers, the lump price is generally quoted for asphalt pavements, and when you come to ascertain the exact condition of things, you cannot rely upon these prices in making comparisons.

MR. McMILLEN, Rochester: While I agree with what has been said in that report, I would like to ask one question, and that is in regard to the prevention of buckling in pavement, by the rolling up of the concrete, which is under the asphalt surface. We have a little trouble in Rochester, N. Y., with the concrete rolling up, and we are making some experiments there. I think, if the Chairman would explain what he has done in his city, it would be of benefit to every person present here.

MR. THOMPSON: We have also been troubled by the expansion of the concrete, which forms ridges in the pavement. Some times these ridges are two or three inches high, extending from one curb to the other. This trouble may not be due to the kind of cement used, but all such cases have occurred where a certain brand of cement was used in the concrete. In order to overcome it, I have during the last year separated the concrete by a space one inch in width at intervals of 300 feet. This space is formed by a board one inch in thickness, placed squarely across the street from curb to curb, against which the concrete is laid on both sides. After the concrete has completely set, the board is removed and the space is filled with sand. In some localities, this space is filled with tar, as noted by Mr. Benzenberg. Mr. Guthrie, of Buffalo, uses the same joint and either leaves it open or fills it with sand. The material in this space compresses sufficiently to take up the expansion of the concrete. Particular care should be exercised to make the ends of the concrete at these joints truly vertical. If they are left slanting, the tendency will be for one section to slide over the other when expansion takes place.

MR. SHERRERD, Newark, N. J.: The Chairman of the committee spoke about using broken stone where the concrete was buckling. I would like to have the reason for its use explained. One other point in the report seems to me might be essential—when repairs are made, to specify that a steam roller must be used upon the streets in these repairs. I know that in some repairs I have had trouble in getting asphalt companies to use their steam roller on the smaller repair work; they can surely do better work with the steam roller than with their light hand roller.

Mr. Pearson, Louisville, Ky.: I want to make a little objection to part of the report. I think everything which has been said refers to Lake asphalt street paving alone, and does not take into consideration anything about Rock asphalt paving. It is an absolute fact (if the gentlemen will inquire into and examine it, as they will find), that all asphalts like the Lake asphalt, etc., take compression at once. It is very rare for them to be compressed to any less thickness than as when first laid. It is exactly the reverse with Rock asphalt. The Rock asphalt does not get its full compression until after two or three years. If you compare the thickness of Rock asphalt with Lake or other asphalts, according to the recommendation of the committee you will take up every Rock asphalt pavement that has ever been laid, because they compress some every year under traffic. If your specifications call for two inches when laid, they would probably compress to one inch and a half in two years, and be just as good, and just as perfect as any of the other kind of asphalt streets, even though less in thickness. Another thing. In the city of Louisville, I tried to have the gutters of one of our streets laid with Lake asphalt, and to get them perfect. It had a very small fall (25-100 in a hundred feet), and I found it a matter of utter impossibility to get these asphalt gutters perfect. In consequence, we have abandoned the use of asphalt for gutters entirely, and use instead an 18-inch wide stone, which we can lay to perfect grade and thereby keep our gutters drained. We could neither roll nor tamp our asphalt gutters to true grade so they would completely drain.

Mr. Lewis: In this connection, before we stop I want to say one word to the members of this convention. They, perhaps, do not appreciate the difficulty of collecting statistical information such as the Committee on Street Paving has endeavored to get, and it is amazing to see the replies which have been received to our questions from engineers—men whom we know to be competent. The carelessness with which these replies are made, is astonishing, and I could mention several instances in which, from my own knowledge of the locality, I know them to have been incorrect, and have had to appeal again to these gentlemen to correct their own mistakes, and, failing in this, have taken the liberty of correcting them myself. I wish to make an appeal to the members of this convention, when questions are sent to them, either to throw them into the scrap basket, and not answer them at all, or, for Heaven's sake, to answer them conscientiously and correctly.

Mr. Thompson: The reason broken stone is recommended to replace the concrete removed from the line of rupture, caused by buckling, is, because if concrete be replaced failure will occur in the same place again, as this will be the weakest point; the broken stone allows room for expansion.

A Member: How wide is this section?

Mr. Thompson: That depends upon the width of the failure. Take out the full section of the buckling and replace it with broken stone.

In regard to the roller, the committee made no attempt to enter into details of construction; that will come under the regular specifications. With reference to the compression of Rock asphalt, the committee plainly stated that the specifications were general, and would have to be modified somewhat in every city, and possibly on different streets in the same city. The intention was to give requirements that would operate as a general guide. If we have done this, a good point has been accomplished for City Engineers in general.

Mr. Lewis: The gentleman from Louisville raising the point about Rock asphalt, the committee did not intend to outline any plan for Rock asphalt. It is a fact that, when Rock asphalt is laid, it is compressed very slightly. It is usually done by hand tamping, and sometimes a light roller is rolled over it to give a more smooth surface; they do depend on the traffic for compression, for the compression, when it is laid, is trifling as compared with what it gets within thirty to sixty days with traffic. The point Mr. Pearson made is worthy, certainly, of consideration, and Rock asphalt pavement will inevitably show a greater decrease in thickness than will the artificial pavement made from the Trinidad Lake asphalt or any other Lake asphalt.

Mr. Adam: According to that wouldn't it be unwise to use Rock asphalt on the streets?

Mr. Thompson: I think it is; I think the Rock asphalt can only show to advantage under heavy traffic.

Mr. Benzenberg: If I may be permitted, I have been requested to ask, if any one has had experience with an asphalt contractor refusing to make the repairs that were required, and in case of refusal, what was the action of the engineer or the Board?

Mr. Rosewater: I can answer with reference to that subject. In 1892 the Barber Asphalt Company had a contract in the city of Omaha for the maintenance of the streets in a continuous good condition for a period of ten years. The contract seems to have been drawn up by themselves, and it provided—the provisions were as indefinite as they could be—and had been adopted without any consideration; however, they declined to make the repairs only as they chose, and the remedy that we applied was the refusal to pay for anything upon the streets, and in order to make a record, they claimed that in the past years the city had already withheld some money from them, and it was a question of fact of what parts of the streets were not or were repaired, and in order to protect the city and compel them to enter into the court and leave the city in a position to protect itself in the courts, we adopted the plan of monthly inspection. An ordinance was adopted, making it a duty of the engineer to report monthly upon the condition of all the streets embraced in the contracts we drew up. We made an original drawing and tracing of the entire area, and divided it up into ten square foot sections, and we made an investigation every month and reported every depression or hole that required attention upon that plat, and by a monthly application of these monthly repetitions and making a record on them, the company finally came to it and resurfaced a large number of the streets until the record was eliminated. In other words, the records showed so badly, and were being examined by parties visiting the city with a view to seeing how these repairs were made, and seeing the plats did the company a great deal of harm, and ultimately they sent a party who made a new appointment for the company in the city and he proceeded to resurface, and within six months we had the entire area resurfaced and put in proper condition, and from that time on, and by continuing for another year, that process of records, we had no further trouble in the city. Of course, the city at no time took any position—that is, they had no means of making their own repairs. I do not know of any city in the United States that is in a position to make its own repairs; what the city could do now, in Omaha, they have four plants of competing companies—at least two, and the city could let a contract and order the work done under the provisions of the contract, and charge it up to the company, but within the last few years, since this method of recording has been put into operation, we have had no trouble in the maintenance of these contracts.

MR. ADAM: Do I understand the gentleman from Omaha to say that this is the method now pursued at the present time of keeping a record of the entire area, every ten feet, on each plat—that is a herculean job for a city like Brooklyn, or Buffalo?

MR. ROSEWATER: It is a much more simple job than would be ordinarily supposed. One man, in four or five days, took in twenty odd miles of the city. The main dependence is the large plats. We have suspended a portion of this in the last year, by simply taking notes of points that ought to be repaired and sending notes to the company. As the company has willingly gone ahead and obeyed orders, we have had no trouble with them; but should any disposition be shown not to keep these streets in repair as required, this is, I think, the most effective remedy, because it places in the hands of the city a record that can be brought before the courts at any time, and no matter what the administration is, makes a record showing a certain number of holes, and a certain number of cracks, and at the end of the next month the same cracks and the same holes are shown, only larger, and still kept on growing larger; such evidence as that in any court would protect the city in any suit.

MR. ADAM: You have abandoned the maps, then?

MR. ROSEWATER: We have for the present, for the reason that they brought about the result that the contractors keep the streets in repair; they maintained for awhile that they were the sole arbitrators, and refused to obey the orders of the city officers, and in this way we brought them to tow.

MR. ADAM: How many cities have it in their specifications, in ordering the company to make repairs, when the engineer finds it necessary, leave it at the liberty of the company, to make the repairs when they see fit, leaving it entirelv to their judgment? I know that some specifications don't have that compulsion of having the company make the repairs where necessary—then it is left to the mercy of the company.

MR. BROCKMAN, Milwaukee: What you are trying to get at is, that the company should make the repairs in five or ten days. Omaha went around the bush for three months, getting them to do it; what procedure does any city take in such a point as that?

MR. PEARSON: I can answer for our city; just simply hold up all payments.

MR. ROSEWATER: Then you have got to wait four or five or six months.

THE PRESIDENT: Before proceeding, I will say that the paper of Mr. Holman came here this morning on "Paving Brick Tests," 38 pages typewritten, including seven or eight tables.

On motion the same was referred to the Executive Committee, to prepare the same for printing in the proceedings.

STANDARD TESTS FOR PAVING BRICK.

BY M. L. HOLMAN, COMMISSIONER OF WATER WORKS, ST. LOUIS, MO.

In June, 1895, the Street, Sewer and Water Commissioners of St. Louis established a laboratory for the purpose of testing the materials of construction used on public work. Before that time, each department was equipped with apparatus for testing cement, but tests on other material were conducted elsewhere, as occasion required. A laboratory under the Water Department had been maintained during the extension of the water works at the Chain of Rocks, and was fully equipped with apparatus for testing cement.

The new laboratory was located in the basement of the Second District City Building, No. 2322 Clark avenue, a room twenty-six by thirty feet, that was originally built for such purpose. The Water Commissioner was invited to act as director, and under his direction the laboratory was arranged for testing cement on an extensive scale.

The first subject demanding attention after the testing of cement had been provided, was that of paving brick. For a year or two before that time, vitrified brick had been used in paving several alleys in the city and its use for street paving was soon to follow. It was, therefore, thought desirable to undertake a series of experiments on paving brick, in order to arrive at definite methods of making tests for obtaining comparative results.

In February, 1895, at the annual convention of the National Brick Manufacturers' Association, a committee was appointed for the purpose of reporting on the proper tests to be applied to paving brick and the best methods of conducting them. The first meeting of this committee was held in Indianapolis, August 1st, 1895. At this time, it was decided that a large amount of experimental work would be necessary. A provisional standard series of tests and methods were, therefore, agreed upon as a basis of conducting the experiments and the work was apportioned among the various members of the committee.

Within the past ten years the use of vitrified brick for street paving has extended from small towns, under very light traffic, to cities, where it is found chiefly in the residence districts, where traffic is light or moderate. This has been rendered possible by the rapid development in its manufacture from the hand made, soft burnt material to the vitrified product made under the conditions existing at the present time. This growth in the manufacture and use of paving brick in cities and towns naturally led up to the application of physical tests by municipal engineers, to guide them in the selection of the best and to prevent the use of poor material on the streets. On the other hand the manufacturer for his own protection and benefit executed similar tests resulting in the steady improvement of his product.

A review of the literature on paving-brick tests, together with the information obtained from a circular sent to the City Engineers of most of the leading cities in the United States, has shown that in most cases no tests were made and in others the tests applied were crude and variable in different places. The greatest variation was found in the rattler test. The material of construction and the form of the barrel used varied greatly. The dimensions of the barrel ranged from twelve to forty-eight inches in diameter and from eighteen to sixty inches in length; the speed from one hundred to ten rev. per minute, and the time of tumbling from twenty minutes to six hours. The composition of the charge differed in almost every case. When iron was used as the abrading material, the size varied from that of shot to large pieces of scrap iron weighing seven pounds or more. Cast iron blocks, granite, and various kinds of rock, all made approximately the same weight and form of the standard brick, as well as brick of different manufacture, were all used varying greatly in amounts. Billets and blocks of wood were sometimes used as a cushioning material. The number of bricks to be tested varied from three to forty, the larger number being composed of bricks of different manufacture, and sometimes small cubical specimens were cut from whole bricks for test. The percentage of loss was calculated after a period of continuous tumbling or after successive intervals. The loss during the first period was sometimes neglected.

The absorption test was found to be more generally used than any other, but the time and manner of drying and soaking, and the size and condition of specimen varied in every possible way. The cross-breaking, crushing and specific gravity tests were not employed to any great extent.

Under the conditions existing it was impossible to prepare general specifications for the use of paving brick that would give satisfaction to all concerned. The best that could be done, was to arbitrarily choose some special tests, governed by local conditions. Specifications in different places were found to be meager in their requirements, and as variable as the method of making the tests themselves. The result has been an endless controversy between manufacturers, contractors and city authorities.

When the St. Louis laboratory was started, it was the intention to make a thorough investigation of each individual test that had been commonly applied to paving brick, and, finally, to select only those that were found necessary for determining the essential qualities of the material for a pavement. On account of the small floor space of the testing station, however, it was found impossible to install the necessary machinery for all the tests. What follows will, therefore, be a recital of the experiments that have been made up to the present time.

THE RATTLER TEST.

This test has always been considered, by engineers, to be the most important. It is the only test, thus far devised, for approximating, in a short space of time, the probable damage to the material in the pavement under traffic. The bricks in the street must resist the continuous rolling and jolting of the wheels of vehicles of all kinds, and also the hammering and scraping of the horse's shoes. The rattler test is the result of the impact and abrasion effects conducted continuously and simultaneously for a chosen time, by the tumbling and sliding of the brick upon one another, the abrading material when used, and upon the inside of the barrel. In order that the test should be valuable, however, it is evident that the results obtained should be uniform and comparable.

The rattler selected for the laboratory was similar to the ordinary foundry tumbling barrel, made of cast iron and supported on trunnions. It was placed in a corner partitioned off for the purpose and inclosed in a wooden box to deaden the sound and hold the brick dust. It was composed of fifteen staves forming a regular polygon in section, with dimensions approximately twenty-four inches in diameter and forty-two inches long. Within the chamber a cast iron partition was bolted to three staves, equally spaced around the barrel, and having long slots so that the length could be regulated. This particular size of barrel was chosen because rattlers in general use for testing paving brick had similar dimensions, and it was thought to be the smallest barrel suitable for the purpose. The barrel was operated by a two horse power constant speed electric motor.

The first work undertaken was the calibration of the barrel, or, in other words, to find the effect on a given material of varying the quantity of charge, length of barrel, speed of revolution and time of tumbling. The brick used for these tests were made of pure shale, worked by the stiff mud process and burnt in down draft kilns. One thousand well-burnt samples were selected from one kiln, with the view of obtaining the most uniform specimens possible. They were end cut repressed brick and had rounded edges. The dimensions were 8¼ by 4 by 2½ inches, the volume of one brick being 82½ cubic inches, and the weight slightly less than seven pounds.

Quantity of Charge.—For the first series of experiments the quantity of charge was varied. The partition was set so that a length of thirty inches was obtained. Charges of five, ten, fifteen, twenty and twenty-five per cent. of the total volume of the barrel, computed from the solid contents of the bricks, requiring 16, 24, 32, and 40 bricks, were tumbled for forty and eighty minutes, and the percentage of loss calculated. The results are shown on figure one, from which it will be seen that the greatest loss was obtained when fifteen per cent. of the volume was filled.

Length of Barrel.—The partition in the barrel was next adjusted, so that the length was successively twelve, twenty-one, thirty and thirty-nine inches, fifteen per cent. of the volume being used in each case, requiring ten, seventeen, twenty-four and thirty-one bricks respectively, and the percentage of loss calculated as before after forty and eighty minutes' tumbling. The results are shown on figure two, which shows that the loss is independent of the length of the barrel. As the length is reduced, however, the efficiency of the test is impaired on account of the tendency of the bricks to wedge together instead of tumbling freely.

Speed of Barrel.—The speed was next made, twenty, twenty-five, thirty, thirty-five and forty revolutions per minute, with a constant length of thirty inches and charges of fifteen per cent. For each test the percentage of loss was found after ten, twenty, thirty, forty, sixty and eighty minutes' tumbling. The curves on figure three show the relation obtained for the time of tumbling marked upon them. Neglecting the small irregularities, it will be seen that the losses increase with the speed, and the loss per revolution also increases slightly with the speed: also, that the speed that would produce the greatest loss has not been reached.

Time of Tumbling.—In figure four, the same tests as given in figure three, are plotted with the percentage of loss and time of tumbling as coördinates, and the speed marked on each curve. These may be called "characteristic curves" for the material at different speeds. They show that the loss decreases with each equal successive interval of time during the continuance of the test. The period of greatest proportionate loss appears to be about the first twenty minutes, which is evidently due to the chipping of the edges, after which the wear becomes more and more uniform.

In conducting the experiments, the brick for each charge were weighed on a scale reading from one-fourth to two hundred and fifty pounds. The time of tumbling was observed to the second and the speed maintained constant. The bricks were found to be extremely uniform in weight and structure, and after the rattling of any charge the appearance and weights of individual specimens were conspicuously similar.

Standard Test.—The experiments given above were thought to be all that were necessary in order to establish a standard rattler test for the laboratory. The test adopted and the reasons therefore were as follows:

Figure one shows that the maximum percentage of loss was obtained when the barrel was filled to fifteen per cent., and this quantity of material was therefore chosen for the uniform charge.

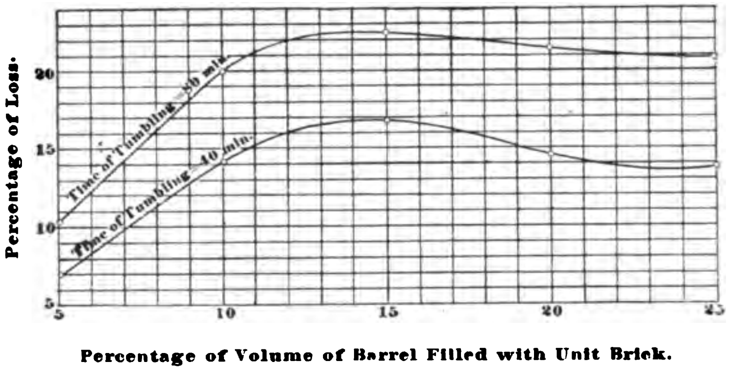


Fig 1.

Diameter of barrel, 24 inches.
Length of barrel, 30 inches.
Revolutions per minute, 30.

Figure two shows that when this charge is used the loss is independent of the length. The movable partition was, therefore, rigidly bolted in the middle of the barrel, making two equal chambers each twenty-one inches in length, so that two tests could be made simultaneously.

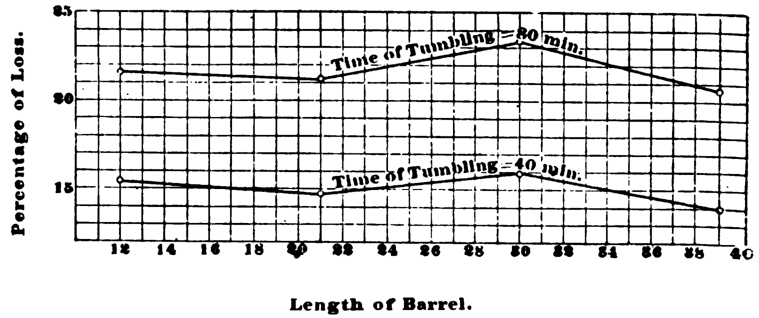


Fig. 2.

Diameter of barrel, 24 inches.
Revolutions per minute, 30.
15 per cent. of volume of barrel filled with unit brick.

Figure three shows that it is necessary to select a definite speed, and thirty revolutions per minute was chosen, since this was about the average speed of rattlers in general use.

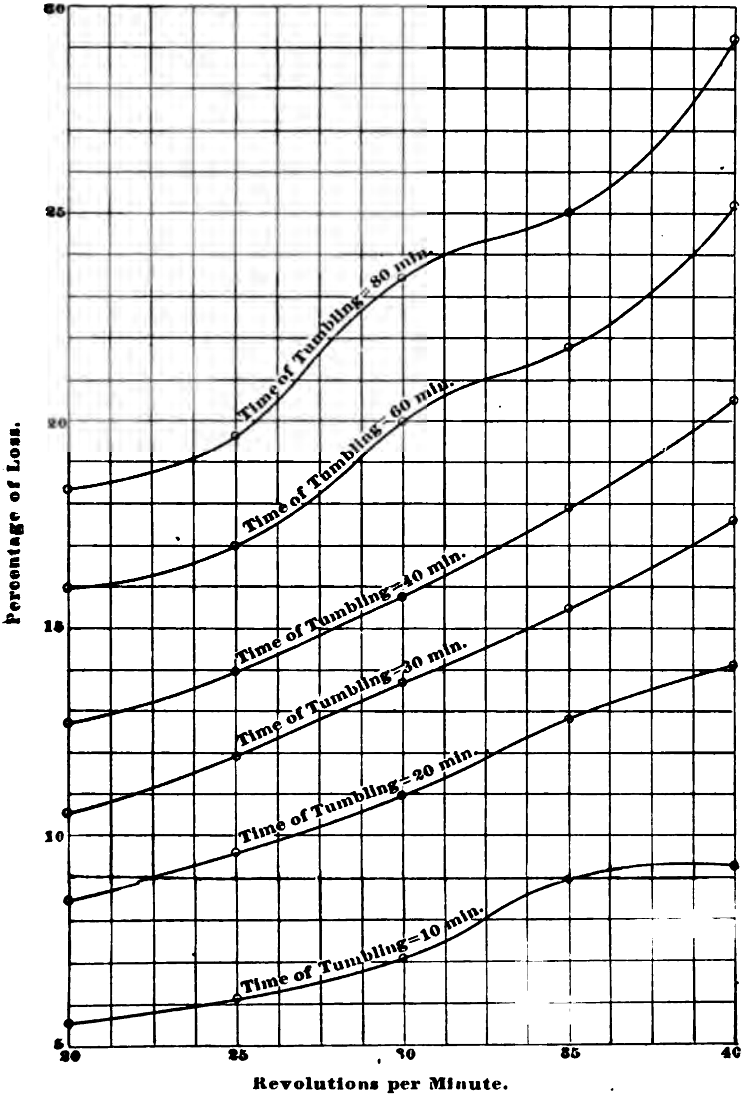


Fig. 3.

Diameter of barrel, 24 inches.
Length of barrel, 30 inches.
15 per cent. of volume of barrel filled with unit brick.

Figure four shows that the edges of the brick suffer the greatest loss during the first twenty minutes, after which the wearing action predominates. As it was thought desirable to make the duration of test as short as possible, forty minutes was adopted.

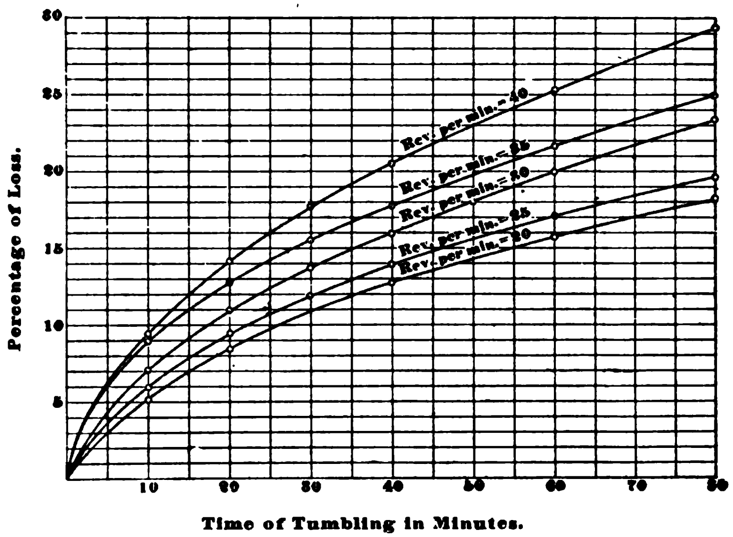


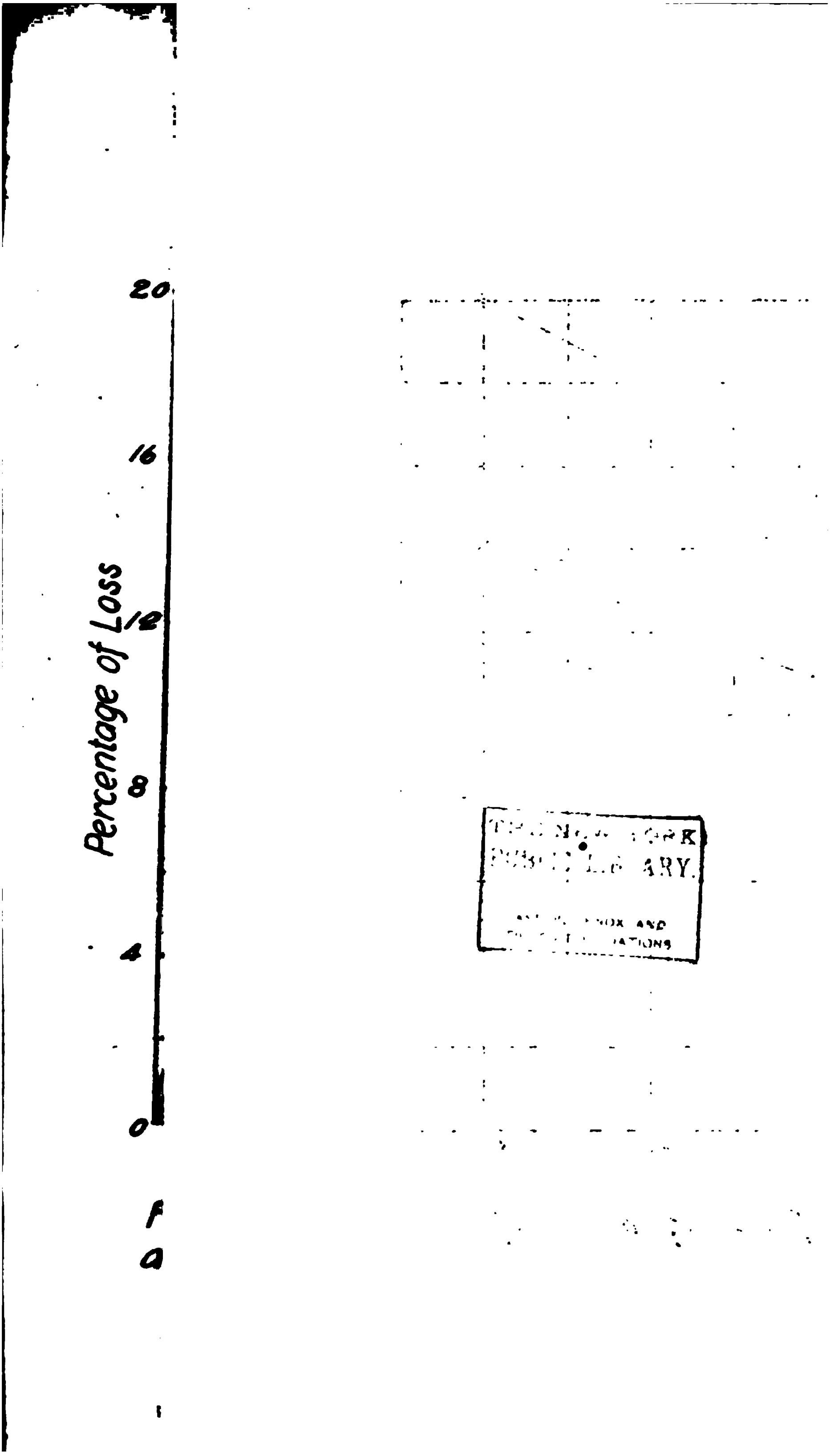
Fig. 4.

Diameter barrel, 24 inches.
Length of barrel, 30 inches.
15 per cent. of volume of barrel filled with unit brick.

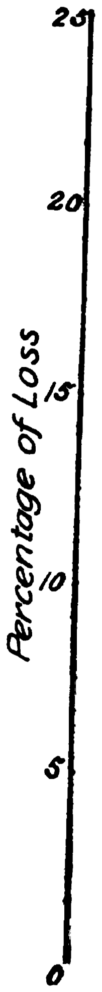
Characteristic Curves.—The conditions governing the standard test being settled, samples of brick were sent by different manufacturers on request, and characteristic curves, previously mentioned, were then obtained. These curves show very closely the rate of loss during the entire rattling process, and are thought to be an excellent indication of the quality of the material and its probable wear in the pavement.

Figure five shows a few of the representative curves. That marked one represents a well burned homogeneous product; number two a hard burned brick with exceedingly tough edges; number three, a well burned brick with brittle edges, and number four, a soft burned homogeneous material.

Under-Burned, Well-Burned and Over-Burned Samples.—A circular was next sent to several manufacturers requesting them to select samples of their under-burned, well-burned and over-burned brick for test. Many requests were granted, but in many cases it was difficult to distinguish the three varieties, all being number one pavers, but differing



THE NEW YORK PUBLIC LIBRARY.
ASTOR, LENOX AND TILDEN FOUNDATIONS



Fi
sa

THE NEW YORK
PUBLIC LIBRARY.

ASTOR, LENOX AND
TILDEN FOUNDATIONS.

slightly in color. In only a few cases, also, were enough of each grade received for the rattler test. Figure six illustrates such a series of tests, the dotted line representing the average of the other curves.

Size of Brick.—In making the various tests, it was noticeable that bricks of large size suffered less than small ones, when tested in the same manner. Uniform samples of brick of the same manufacture made in three sizes, 8"x3¾"x3½", 8"x3¾"x3", and 8"x3¾"x2½", were tested with the result shown in figure seven. Other tests made on two sizes, 9"x4"x3", and 8"x4"x2½", from several makers were found to give lower losses with the larger than with the smaller samples. On the contrary, however, the results of tests on whole bricks and halves of the same manufacture, showed, without exception, that whole bricks lost a larger percentage than half bricks. An example of this is shown in figure eight.

Mixed Charges.—No attempt was made to establish a standard test by the use of iron, stone, brick or any other substance as a filler or abrasion material. It was considered useless to introduce additional variables into the problem. Records of previous experiments proved that this method of making the test could not be relied upon.

There are three reasons usually given for making the test in this way:

1. Fewer sample brick would be required.

2. The use of iron more nearly conforms to the conditions of wear in the pavement.

3. For the purpose of comparing brick with other paving materials.

The objections to each are:

1. Although fewer samples would be necessary for the test, yet the result obtained would be a fairer average if a large number were used.

2. If the iron for the test is in the form of shot or small pieces, the bricks, after the tumbling process, are either polished or slightly worn. If in larger pieces or blocks of six pounds or more, the samples after the test are broken up completely. Let it be supposed that the proper combination of different sizes, and the amount of each to produce a good wearing effect upon the brick, has been obtained by experiment. Then the difficulty of maintaining such conditions during continuous use is apparent. The pieces become highly polished, their rough edges are worn off, and new material must be added from time to time to provide for the loss. A standard test under such variable conditions was not thought possible.

The method first adopted by the Street Department, was to use five bricks and ten cast iron blocks weighing six pounds each for the charge. To show that this test was unreliable, fifteen uniform samples were divided into three lots of five each and tested in the above manner.

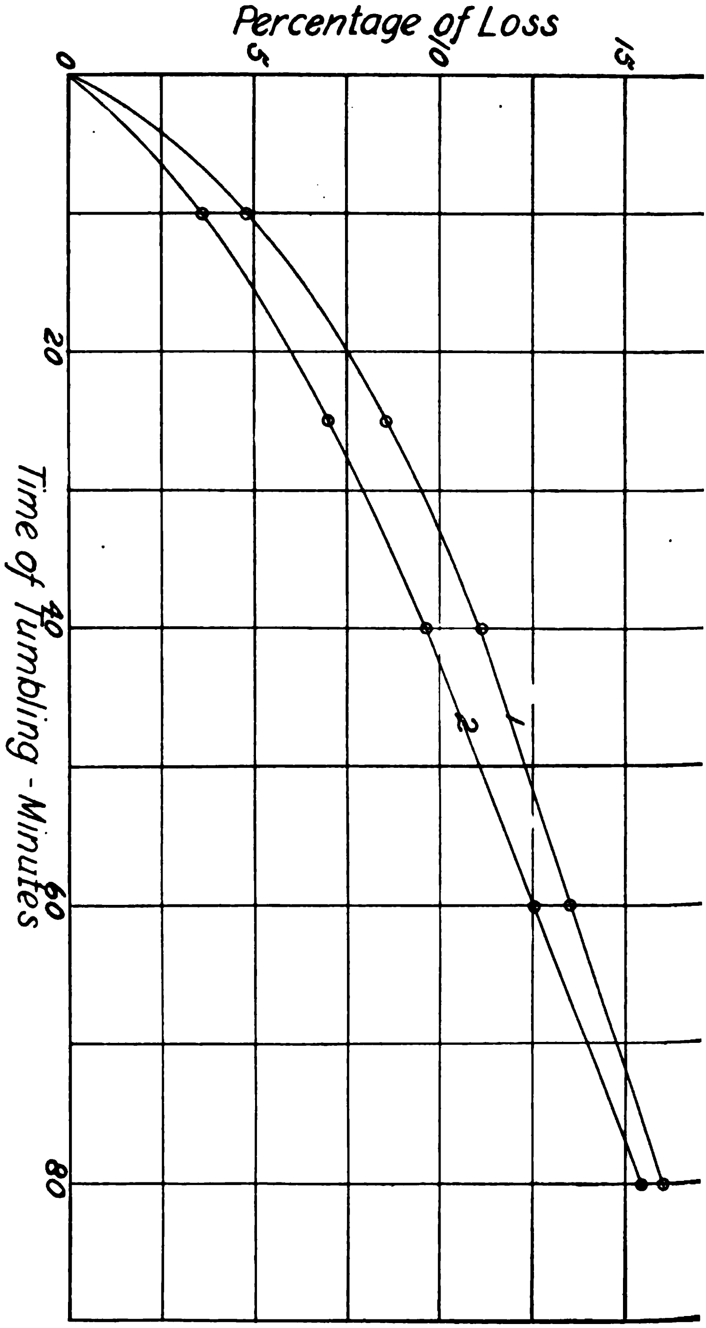


Fig. 8 Rattler tests on (1) whole and (2) half bricks of the same manufacture

Figure nine shows the results, the numbers on the curves giving the order in which the tests were made. It will be seen that these curves are very irregular, and this method was therefore abandoned.

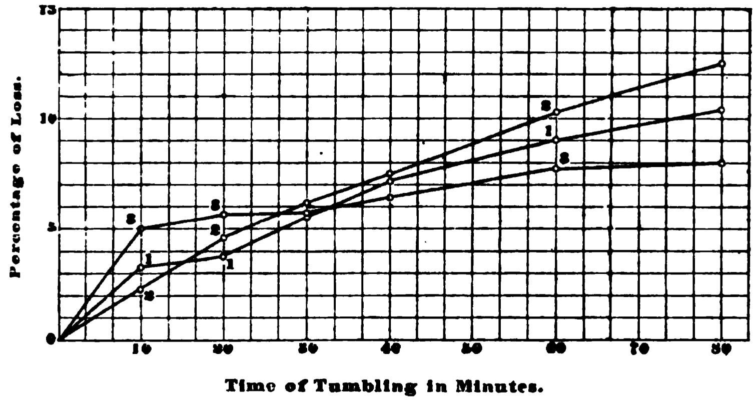


Fig. 9.

Experiments with cast iron blocks in rattler.
Diameter of barrel, 24 inches.
Length of barrel, 21 inches.
Revolutions per minute, 30.
Charge for each test, 5 unit brick and 10 cast iron blocks.

3. The method employed in the laboratory for the comparison of brick with other paving material was to test each separately in the regular manner. Figure ten shows curves obtained on five different varieties of granite used for paving in St. Louis. The specimens were approximately the size and form of the standard brick. The curves marked one, three and five, are smooth, and represent the soft varieties with large granular structure, while two and four are not so regular, and represent the dense fine-grained varieties.

When brick and granite are tumbled together, the result is not the relative comparison of their wearing qualities in a pavement, because the effect of the granite on the brick is much more severe than that of the brick on the granite. Moreover, the conditions of the charge can rarely be duplicated and variable results follow.

THE ABSORPTION TEST.

To make the test, the water contained in the samples is first evaporated, after which they are immersed in clear water for a given time. The increase in weight divided by the dry weight gives the percentage of water absorbed for that time.

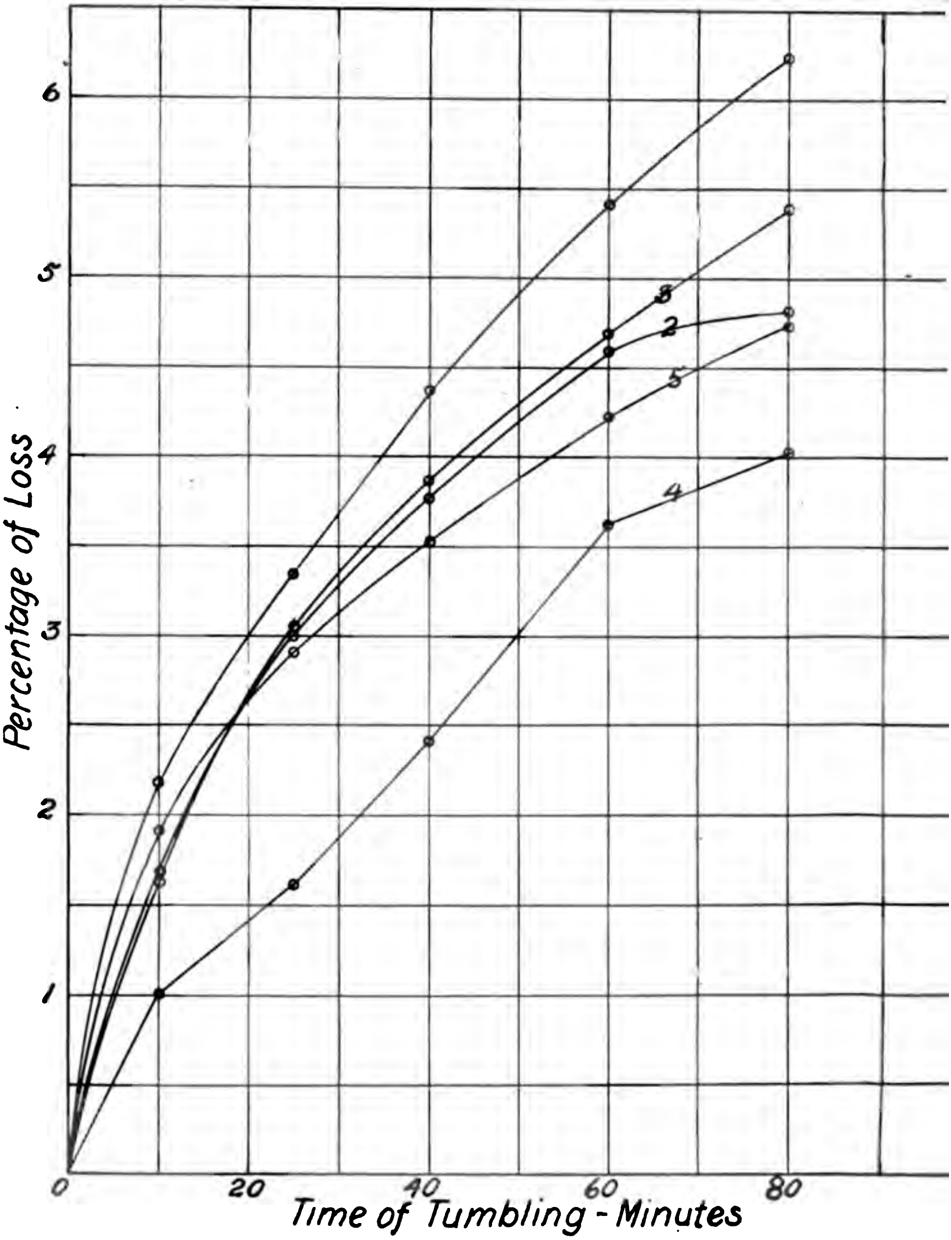


Fig. 10 Rattler tests on five different kinds of gr
used for paving in St. Louis.

The bricks for the absorption tests were dried in a gas oven designed for the purpose. It is made of galvanized iron, lined throughout with asbestos. The temperature could be well regulated and was maintained between 220° and 240° F.

Drying.—The first point to be determined, was the time required to thoroughly dry the samples. For this purpose two bricks from each of eleven different manufacturers were placed in the oven and weighed at various intervals of time. Figure eleven shows the manner in which the moisture is evaporated, each curve being the average of two bricks, and the broken line represents the general average.

When bricks for test have been brought from the street where they have been exposed to the weather, they are liable to contain more water than in the case where they are sent from the kiln. To investigate this matter the same samples used in the previous test, when thoroughly dry, were immersed in water twenty-four hours and the evaporation process repeated. The corresponding letters on the curves of figure twelve represent the same samples as shown on figure eleven, each curve being the average of two bricks as before and the broken line the average of all. These two cases, it is thought, cover all the conditions of the state of moisture of bricks likely to be received at the laboratory for test.

The results of these tests show that it requires four days to dry vitrified brick at a temperature ranging from 220° to 240°, under usual conditions of moisture, and that in forty-eight hours they are practically dry. Thus 94.1 per cent. of the total amount contained in the bricks sent by the manufacturers and 95.7 per cent. of the amount absorbed by these samples in twenty-four hours was evaporated in forty-eight hours.

Soaking.—The next step was to ascertain the proper length of time for soaking vitrified brick, and the condition of the samples to be used in order to obtain comparative results. For this purpose three uniform samples from eleven different manufacturers were selected and dried for forty-eight hours. Two bricks of each kind were immersed whole. Both ends of the third brick of each were removed, leaving half bricks with two interior surfaces exposed to absorb water. A small piece was also taken from the interior of the third brick of each kind, weighing about 25 grams, for test. Figure thirteen shows the results of the whole bricks, each curve being the average of two samples. These same curves are given again on figure fourteen to show more clearly the rate of absorption for the first three days. The curves of figure fifteen represent the half bricks, and those of figure sixteen the small pieces, Each kind of brick is given a number, which is marked on the corresponding curves in the figures.

Figures thirteen and fifteen show that whole and half bricks continue to absorb for twenty-four weeks, at which time the experiments

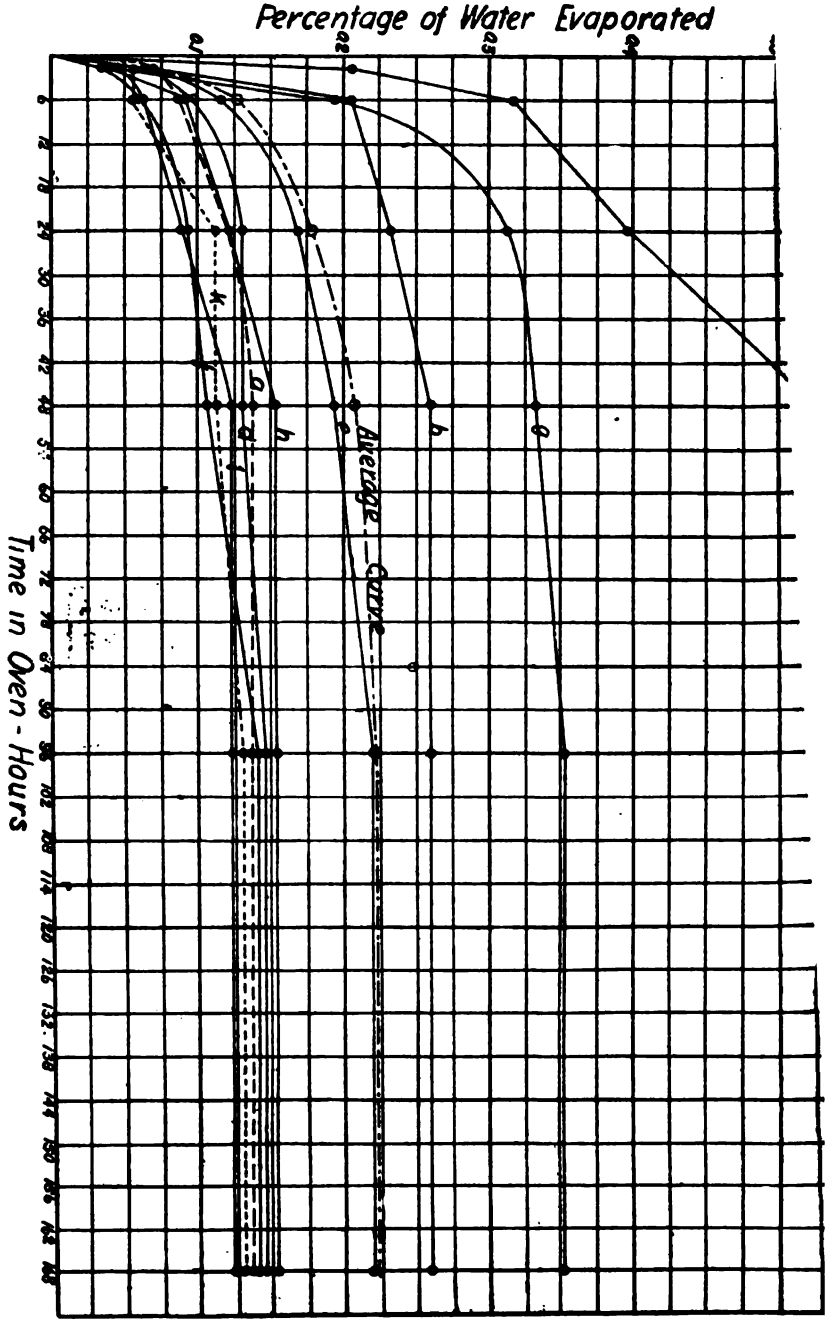
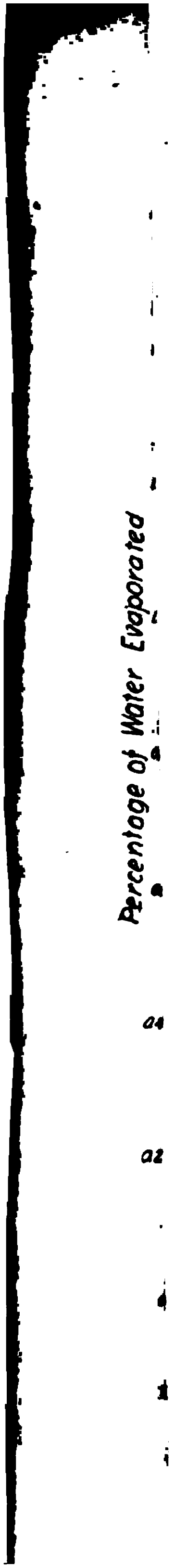


Fig. 11.

Drying Tests. Normal moisture. Each curve is the average of two bricks. Temperature of oven, 220° to 240° F.



YORK
BRARY

RK
ARY

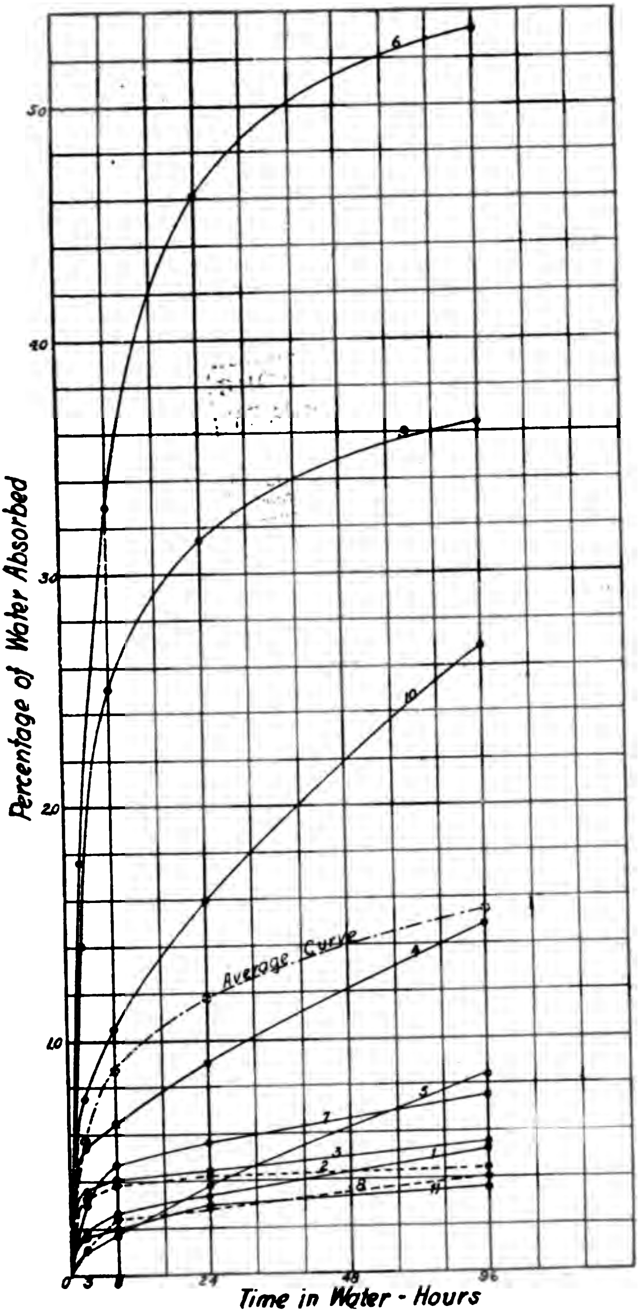


Fig. 14.

Absorption Tests. Whole bricks tested. Each curve is the average of two bricks.

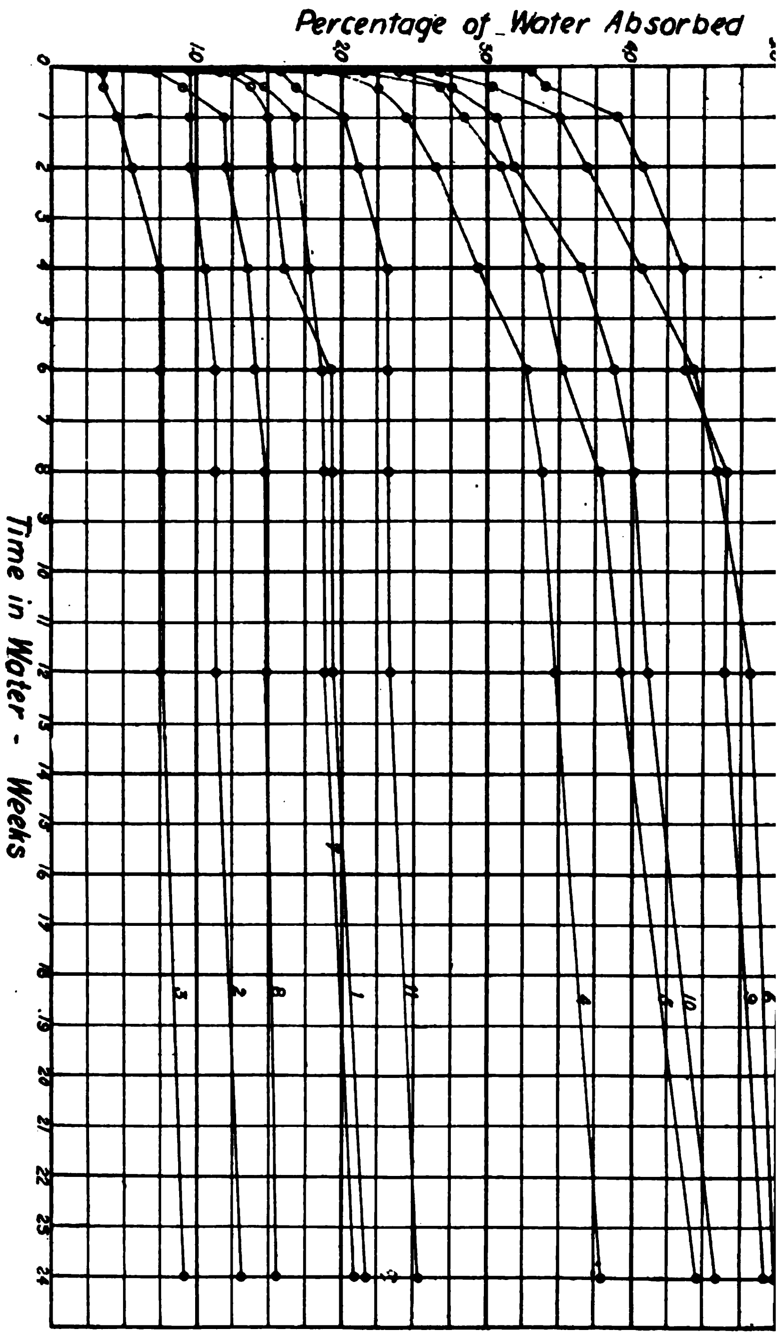


Fig. 15.

Absorption Tests. Half bricks tested. Both ends of each brick removed, leaving two surfaces from interior exposed. Reference numbers marked on curves.

were discontinued. Also, that in eight weeks the whole amount was practically taken up. The percentage of absorption of the half bricks ordinarily exceeds that of whole ones of the same manufacture. Thus, after twenty-four weeks of immersion, the percentage is greater for half bricks than for whole ones except in numbers three, six and ten. The average increase of half over whole bricks at that time is 16.5 per cent.

Figure sixteen shows that the absorption process is still going on after eight weeks' immersion also, that the percentage of absorption in eight weeks exceeds that of half bricks of the same manufacture, except in the case of number eight, and that of corresponding whole ones without any exception. The average increase of small pieces over half bricks in eight weeks is 47.3 per cent., and over whole ones in same time 66.1 per cent.

Figure seventeen shows the average absorption curves of whole bricks, half bricks and small pieces.

In the preceding experiments the surplus water was removed from the surface of the samples with a dry cloth. The whole and half bricks were weighed on a balance to the nearest gram, and the small pieces were weighed on a chemical balance.

Standard Absorption Test.—A review of these experiments shows, that it is not practical to completely soak the brick for the absorption test, and that the percentage taken up depends on the size and condition of the sample. Since it is desirable to make the test in the shortest possible time, it was decided to dry five samples for forty-eight hours, and immerse for forty-eight hours for the standard test. The exterior surfaces of different kinds of brick more or less impede the penetration of water, on account of variations in manufacture and treatment by salt glazing. For the comparative tests whole bricks after rattling were used for samples.

Drying in Air.—The whole and half bricks that had been soaked for twenty-four weeks were removed from the water, wiped with a cloth, and allowed to dry in the laboratory at an average temperature of about 70° F. They were weighed after one, two, five, thirteen, twenty-six, fifty, seventy-three and ninety days' drying, and the percentage of evaporation was found by dividing the loss in weight at the various intervals of time, by the total weight of water absorbed in twenty-four weeks. Each curve on figure eighteen is the average of two bricks, and the broken line shows the general average. The curves on figure nineteen represent half bricks, and the dotted line the average of all. The corresponding numbers on each figure represent whole and half bricks of the same manufacture, and the percentage of water absorbed in twenty-four weeks are also marked on the curves.

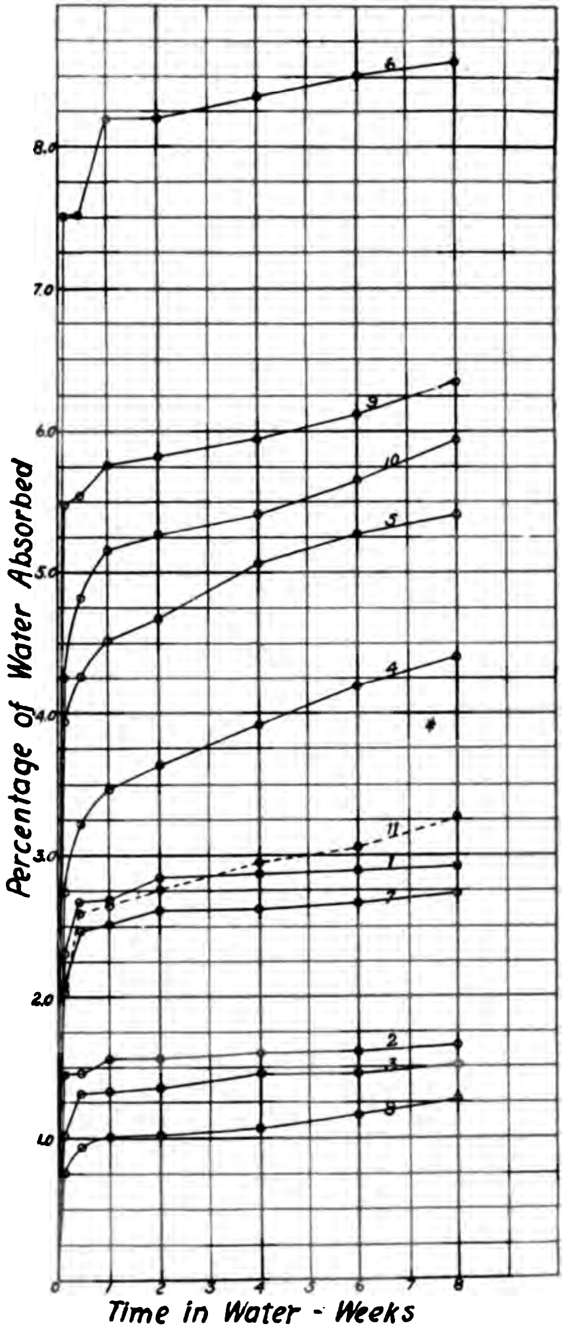


Fig. 16.

Absorption Tests. Small pieces from interior tested. Each curve represents one piece.

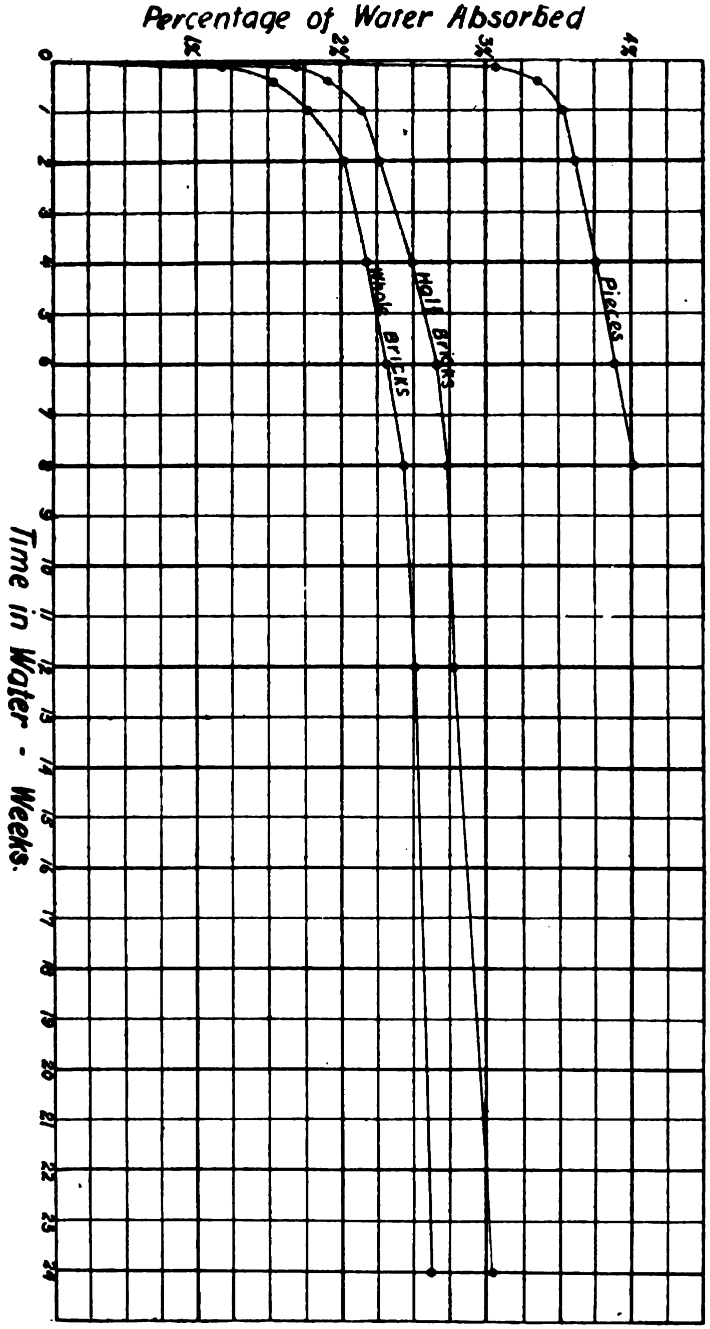


Fig. 17.

Absorption Tests. Resulting average curves of whole bricks, half bricks and small pieces.

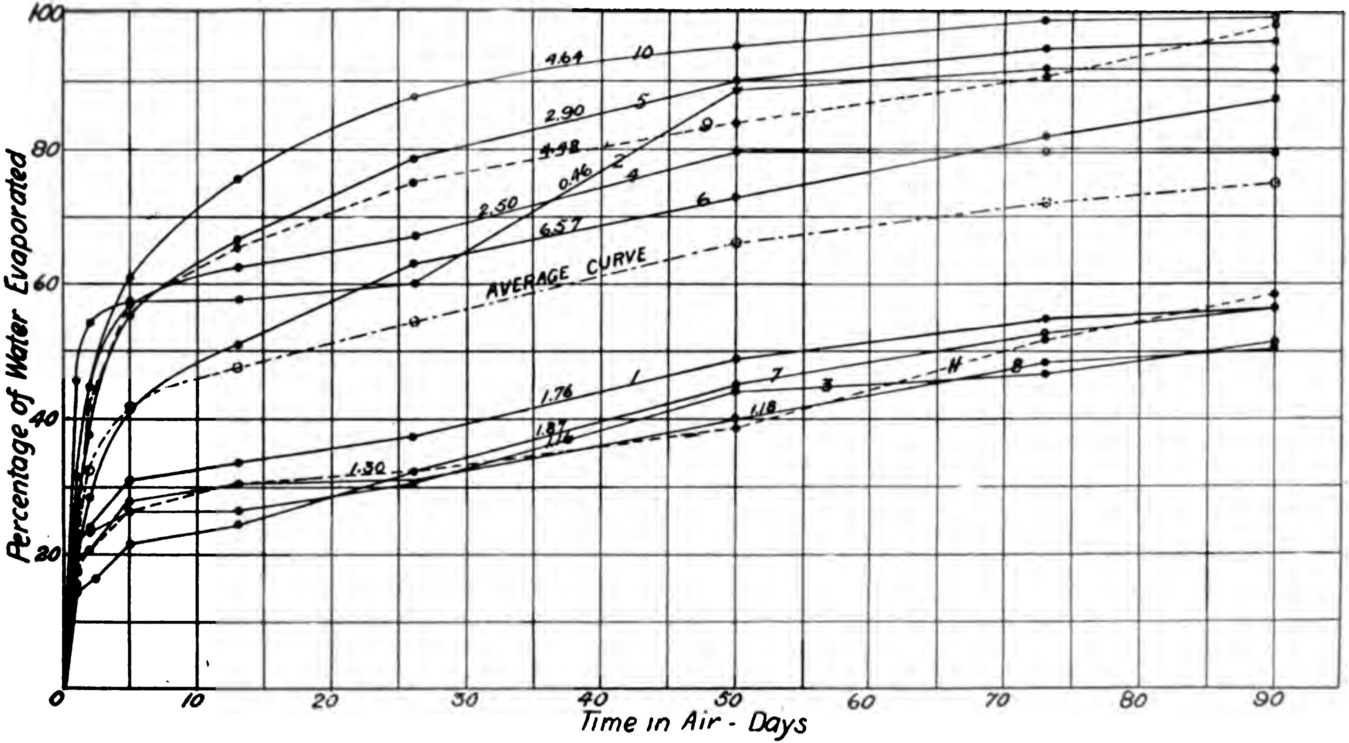


Fig 18 Tests on drying paving bricks of different manufacture, in the air, at an average temperature of 70° F. Each curve is the average of two bricks.

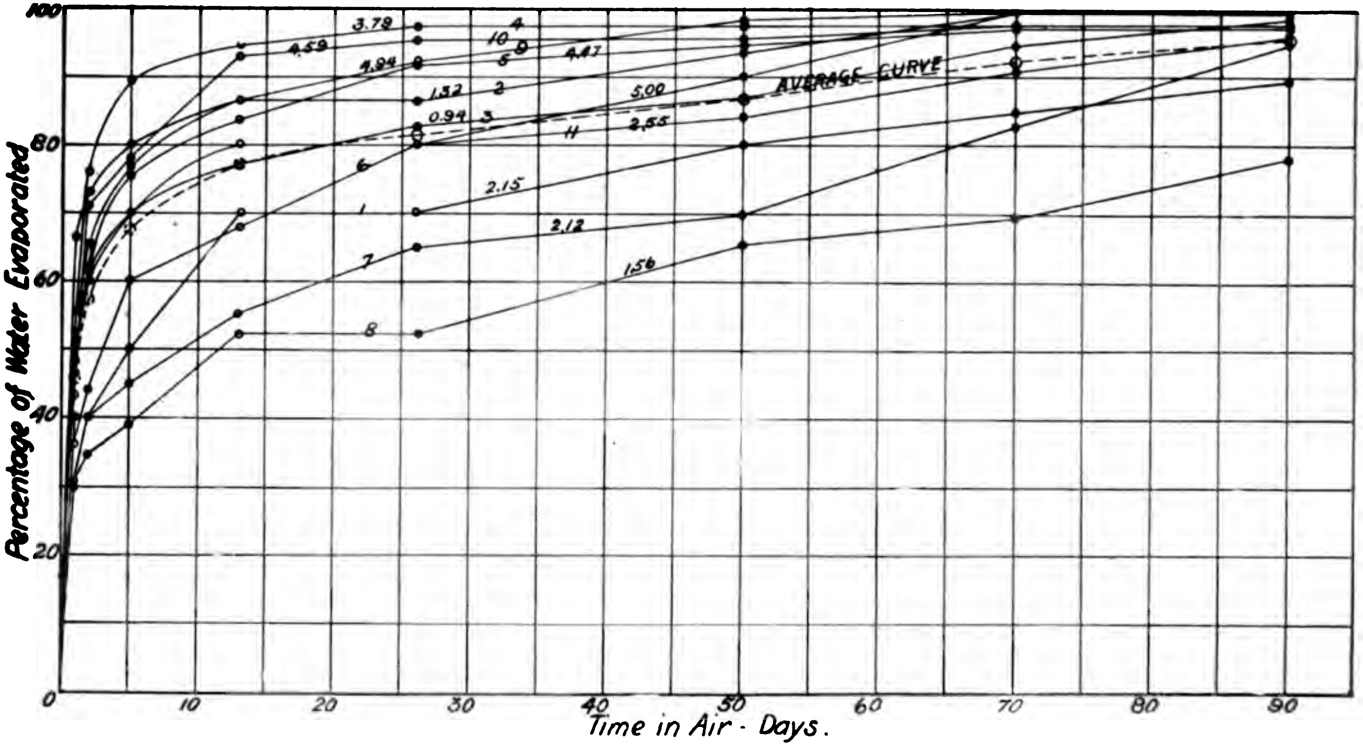


Fig. 19 Tests on drying half bricks of different manufacture in the air at an average temperature of 70° F. Each curve represents one half brick.

An examination of figures seventeen and eighteen shows:

1. Half bricks dry in the air more rapidly than whole ones of the same manufacture.

2. Both whole and half bricks that absorb quickly, or that have a high percentage of absorption, also dry rapidly.

3. Both whole and half bricks that absorb slowly, or that have a low percentage of absorption, also dry slowly.

A review of the drying and absorption experiments shows that each is a very slow process. It is doubtful whether the pores in the brick ever become completely filled with water. It is probable that they reach a normal state of moisture, and remain practically in that condition afterwards.

Characteristic Absorption Curves.—The method of making the absorption test having been adopted, a number of absorption curves were obtained on five samples of rattled bricks of different manufacture, which are shown on figure twenty, up to a period of one week's soaking. These may be called characteristic absorption curves, since the amount and rate of absorption is an indication of the structure of the material. Number three represents a fire-clay brick, numbers seven, eight, nine and ten, a mixture of fire-clay and shale; numbers two, four and six, pure shale, and number five, a mixture of shale and surface clay.

THE CROSS BREAKING TEST.

The cross breaking test is an important one for the examination of the structure of paving brick, and for finding its resistance to breaking under heavy loads, when laid in the pavement on an uneven and unyielding foundation.

Testing Machine.—A new testing machine was designed for the special purpose of conducting this test, and was built in the shops of the Water Department. The oil is supplied by a small triplex pump and the pressure in the cylinder is controlled by a system of four conical valves. In order to reduce the friction to the smallest possible amount, the plunger was made to fit loosely in the cylinder and the piston rod in the self-adjusting metal stuffing box. Oil bearings are thus maintained and packing eliminated. To the cylinder are connected a large pressure gauge and a recording gauge, each reading from 0 to 100 pounds.

The brick for test is supported on two steel knife edges, rounded both longitudinally and transversely, and so bolted that a span of six inches is secured. The middle knife edge is connected to the movable cross-head of the machine by means of two steel links.

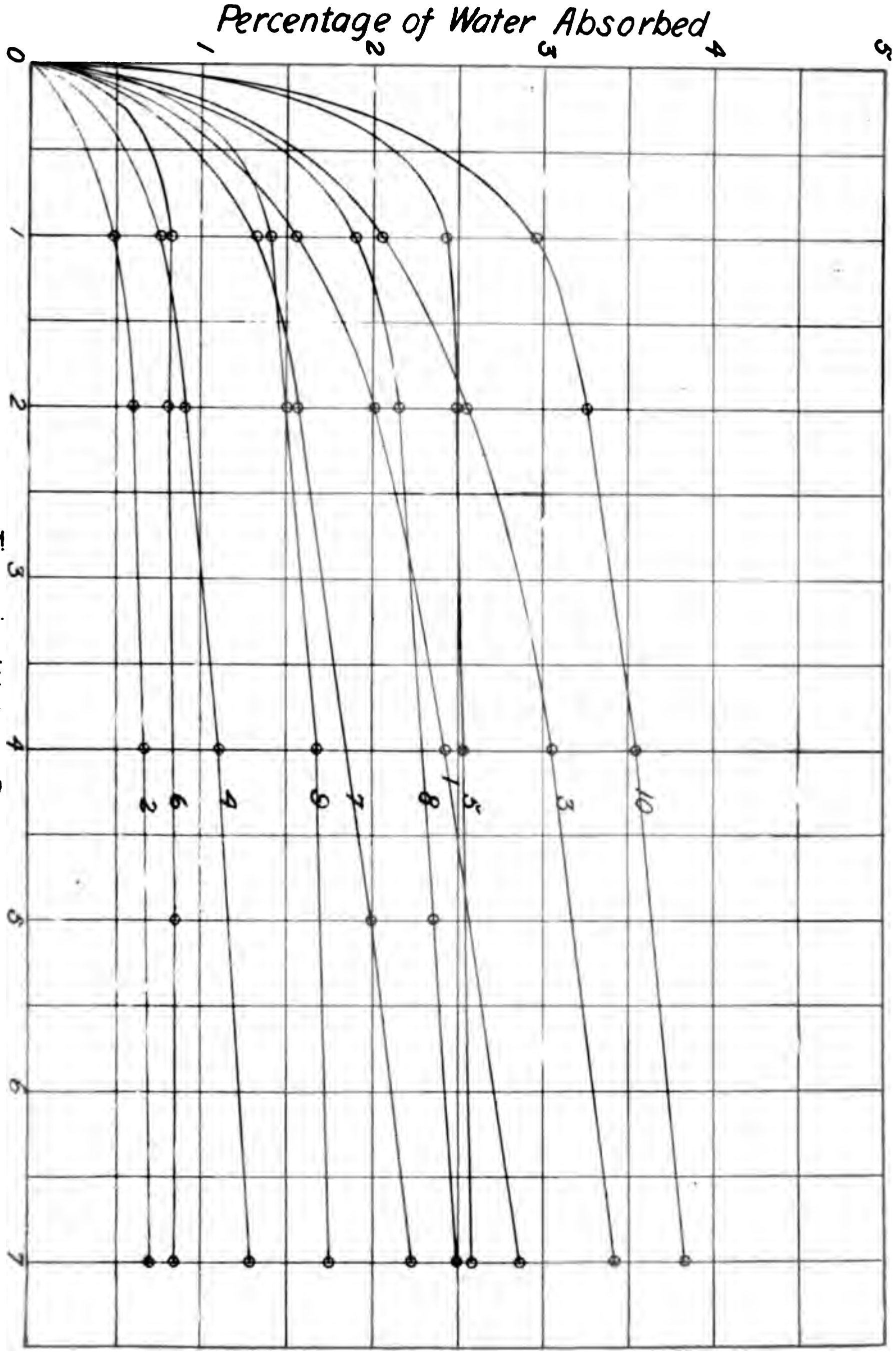


Fig 20 Characteristic absorption curves Each curve is the averages of

The chief features of the testing machine briefly are:

1. The friction is reduced to a very small amount by causing the oil to leak around the plunger and rod, thus maintaining oil bearings and eliminating packing.

2. It is simple in constructing, having very few moving parts.

3. The load on the specimen is under perfect control at all times, and can be applied uniformly, released almost instantly, or held constant for any length of time.

4. The results obtained are accurate to within one per cent.

5. Specimens can be broken for commercial purposes rapidly, without physical labor and by one operator.

6. The load on the specimen is indicated by a pressure gauge, and a record of the tests made is also kept of an autographic recording gauge.

Calculation.—The ordinary cross breaking formula was used for computing the modulus of rupture, as follows:

$f= \frac{3\,W\,1}{2\,b\,d}2$ in which
f=modulus of rupture.
w=breaking load in pounds.
1=span=six inches.
b=breadth of brick in inches.
d=depth of brick in inches.

To facilitate the calculation, a slide rule has been prepared. On the limb are two scales, the upper representing the width of brick in inches, and the lower the modulus of rupture. On one side of the slide, the upper scale represents the depth of the brick in inches and the lower, the gauge pressure corresponding to the total load taken from the calibration line. On the opposite side of the slide, the upper scale represents the depth as on the first side, and the lower the total load in pounds avoirdupois instead of gauge pressure.

In using the rule, the width and depth of the brick having been measured, the depth on the slide is set opposite the width on the limb. Then, opposite the breaking load on the slide, the modulus of rupture is read off on the limb. The modulus can thus readily be found to the nearest ten pounds in the case of the brick tested edgewise or flatwise, broken either on the hydraulic or on some universal testing machine.

Standard Test.—In order to avoid the necessity of grinding the surfaces to parallel planes, and also to reduce the twisting stresses due to the irregularities of those surfaces to a minimum, the lower knife edges were slightly rounded longitudinally. This results in a concentration of stress upon two small areas of the brick in contact with the lower knife edges. In the early experiments these knife edges were sharp, and the specimen broke frequently in a well-defined curved surface, beginning at one of the lower knife edges, fending convex upwards and terminating at or near the upper knife edge.

The lower knife edges were then rounded transversely to a larger radius and this difficulty was practically overcome. Further experiments with bricks of inferior quality, however, showed that occasionally a specimen broke in the above manner, and to counteract this, two remedies were applied with success, the first being to place small steel plates between the lower supports and the brick, and the second, to break the specimen flatwise, thus spreading and reducing the concentrated forces.

The result of a large number of experiments leads to the adoption of the following method of making the cross breaking test:

Support the brick on edge on hardened steel knife, edges well rounded transversely and slightly rounded longitudinally, bolted to secure a span six inches, and apply the load on the middle of top face through a third knife, edge rounded transversely but straight longitudinally. Samples for test should be free from visible irregularities and not less than ten should be broken.

TABLES.

In the following tables are given the results of cross breaking tests on paving brick of different manufacture. The figures represent the moduli of rupture in pounds per square inch.

Table 1. Ten bricks were broken with load applied at rate of 2,500 pounds per second, after which ten of the same kind were broken at the rate of 250 pounds per second. The results are practically the same.

Table 2. Ten bricks were broken edgewise and flatwise on the hydraulic machine, and ten of the same kind were broken edgewise and flatwise on a Riehle twenty thousand pounds testing machine, at Washington University, with practically the same results.

Table 3. These results show the weakening effect of a flaw in the specimen. An examination of the fractured surface shows that numbers eight, nine and ten, under column one, and numbers two and seven, under column two, were more or less air checked, causing a great reduction in their strength. Cross breaking discloses such defects better than any other test applied to paving brick.

Table 4. Tests on a number of well-burned samples of different manufacture were made. The range of variation is found by dividing the difference between the highest and lowest tests by the average in each case. These figures show that there is a large difference in the structural strength of apparently uniform samples. Brittle material was found to be in all cases extremely variable.

Table 5. Samples of different manufacture were broken flatwise and edgewise. Theoretically, for uniform brick of any one make, the results should be equal, but the process of manufacture and repressing tend to vary them. The higher averages of the same kind of brick when broken flatwise than when broken edgewise may be accounted for by the repressing process. From the tests given in the table and others not recorded, it is believed that a comparison of tests edgewise and flatwise on carefully chosen samples is an excellent means of ascertaining the homogeneity of the material.

A number of tests were made on under-burned, well-burned, and over-burned samples of different kinds of brick selected by manufacturers, with the results shown on figure twenty-seven. Owing to the great variation between the different grades received, no definite comparison of the tests can be made. The over-burned samples in all but one instance fall below the well-burned.

SPECIFIC GRAVITY TEST.

This test is made for determining the relative density of paving material. For brick of the same manufacture, it is supposed to indicate the degree of burning. The test was made on a large number of samples previously used for the absorption test, by finding their weight in water and solving the formula:

Specific gravity $= \frac{W}{W' - W''}$ in which

W = dry weight in air.

W' = weight in air after soaking.

W'' = weight in water after soaking.

A purely theoretical relation between the percentage of absorption and the specific gravity of the clay and brick is derived as follows:

Let W_1 = dry weight of brick in air.

V_1 = weight of volume of water equal to volume of clay.

V_2 = weight of volume of water equal to volume of brick.

Then $\frac{W_1}{V_1}$ = specific gravity of clay $= S_1$.

$\frac{W_1}{V_2}$ = specific gravity of brick $= S_2$.

$\frac{W_1}{V_1}$

And $$\frac{\qquad\qquad}{\frac{W_1}{V_2}} = \frac{S_1}{S_2} = \frac{V_2}{V_1} \qquad (1)$$

Let $\frac{X}{100} =$ percentage of water absorbed.

Then $\frac{X}{100}$ W_1=weight of water absorbed.

And $$V_2 = V_1 + \frac{X S_1 V_1}{100} \qquad (2)$$

Substituting (2) in (1), we have

$$\frac{S_1}{S_2} = 1 + \frac{X\ S_1}{100} \text{ or } \frac{S_1 - S_2}{S_1 - S_2} = \frac{X}{100}$$

Thus, if the specific gravity of the clay in the form of a powder and of the brick itself were obtained, the total amount of water that could be taken up would follow.

Complete Tests on Brick of Different Manufacture.—The next series of experiments consisted in making complete tests on several kinds of brick sent by different manufacturers in accordance with the methods previously adopted and herewith described.

Rattler Test.—Diameter of barrel equals twenty-four inches and length equals twenty-one inches. The chamber was filled to fifteen per cent. of its volume, and the charge tumbled for forty minutes at thirty rev. per minute.

Absorption.—Five rattled bricks were dried forty-eight hours and immersed forty-eight hours.

Specific Gravity.—From same samples used for the absorption test.

Cross Breaking.—Span equals six inches, and average taken of ten bricks broken on edge.

Table 6. Shows the results of these tests.

The final meeting of the Committee of the National Brick Manufacturers' Association for the adoption of standard tests was held in Indianapolis, January 22d, of the present year. Besides the data given above, Mr. Edw. Orton, Jr., Professor of Clay Working and Ceramics of the Ohio State University, to whom had been assigned the standardization of the rattler test by the committee at its first meeting, presented an elaborate series of experiments and charts on the subject. Prof. Orton's barrel was made according to the specifications for a preliminary standard barrel decided upon by the commission. It was of cast iron, revolving on trunnions, twenty-eight inches in diameter, and sixty-one inches long, with movable diaphram for varying the length. A well-burned, very uniform batch of four thousand bricks was obtained from one kiln from the Canton Brick Company, of Canton, Ohio, for the experiments. Since a pamphlet is now being written by Prof. Orton for publication by the National Brick Manufacturer's Association, it is thought sufficient to give—

The Standard Tests Adopted by the National Brick Manufacturers' Association.—From a critical examination of all the data submitted to the commission, the following report was unanimously adopted:

RATTLER TEST.

1. Dimensions of the Machine.—The standard machine shall be twenty-eight inches in diameter and twenty inches in length, measured inside the rattler chamber.

Other machines may be used varying in diameter between twenty-six and thirty inches and in length from eighteen to twenty-four inches, but if this is done, a record of it must be attached to the official report. Long rattlers may be cut up into sections of suitable length by the insertion of an iron diaphram at the proper point.

2. Construction of the Machine.—The barrel shall be supported on trunnions at either end; in no case shall a shaft pass through a rattling chamber. The cross section of the barrel shall be a regular polygon. The heads and staves shall be composed of gray cast iron, not chilled or case hardened. There shall be a space of one-fourth of an inch between the staves for the escape of dust and small pieces of waste. Other machines may be used having from twelve to sixteen staves, with openings from one-eighth to three-eighths of an inch between staves, but if this is done a record of it must be attached to the official report of the test.

3. Composition of the Charge.—All tests must be executed on charges composed of one kind of material at a time. No test shall be considered official where two or more different bricks or materials have been used to compose a charge.

4. Quantity of the Charge.—The quantity of the charge shall be estimated by its bulk, and not its weight. The bulk of the standard charge shall be equal to fifteen per cent. of the cubic contents of the rattling chamber, and the number of whole brick whose united volume comes nearest to this amount shall constitute a charge.

5. Revolutions of the Charge.—The number of revolutions for a standard test shall be eighteen hundred, and the speed of rotation shall be thirty per minute. The belt power shall be sufficient to rotate the rattler at the sme speed whether charged or empty. Other speeds of

rotation between twenty-four and thirty-six revolutions per minute may be used. but if this is done a record of it must be attached to the official report.

6. Condition of the Charge.—The bricks composing a charge shall be dry and clean. and, as nearly as possible, in a condition in which they are drawn from the kiln.

7. Calculation of the Results.—The loss shall be calculated in per cents of the weight of the dry brick composing the charge. and no results shall be considered as official unless it is the average of two distinct and complete tests, made on separate charges of brick.

ABSORPTION TEST.

1. The number of bricks for a standard test shall be five.

2. The test must be conducted on rattled brick. If none such are available. the whole bricks must be broken in halves before treatment.

3. Dry the bricks for forty-eight hours at a temperature ranging from 230° to 250° F. before weighing for the official dry weight.

4. Soak for forty-eight hours, completely immersed in pure water.

5. After soaking, and before weighing, the bricks must be wiped dry from surplus water.

6. The differences in the weight must be determined on the scales sensitive to one gram.

7. The increase in weight due to water absorbed shall be calculated in per cents of the initial dry weight.

The following resolution was then presented, and, after most careful discussion of all the facts brought out by the data of Messrs. Harrington and Orton, was unanimously adopted:

> "Resolved, That, in the opinion of the commission, any paving brick which will satisfy the requirements of reasonable mechanical tests will not absorb sufficient water to prove injurious to it in service. We, therefore, recommend that the absorption test be abandoned as unnecessary, if not actually misleading."

CROSS BREAKING TEST.

1. Support the brick on edge, or as laid in the pavement, on hardened steel knife edges, rounded longitudinally to a radius of twelve inches, and transversely to a radius of one-eighth inch, and bolted in position so as to secure a span of six inches.

2. Apply the load to the middle of the top face through a hardened steel knife edge, straight longitudinally and rounded transversely to a radius to one-sixteenth inch.

3. Apply the load at a uniform rate of increase till fracture ensues.

4. Compute the modulus of rupture by the formula

$f=\frac{3\ W.\ 1}{2\ b\ d2}$ in which

f=modulus of rupture in pounds per square inch.

W=total breaking loads in pounds.

1=length of span in inches=6".

b=breadth of brick in inches.

d=depth of brick in inches.

5. Samples for test must be free from all visible irregularities of surfaces or deformities of shape, and their upper and lower faces must be practically parallel.

6. Not less than ten brick shall be broken, and the average of all be taken for a standard test.

CRUSHING TEST.

1. The crushing test should be made on half bricks, loaded edgewise, or as they are laid in the street. If the machine used is unable to crush a full half brick, the area may be reduced by chipping off, keeping the form of the piece to be tested as nearly prismatic as possible. A machine of at least one hundred thousand pounds' capacity should be used, and the specimen should not be reduced below four square inches of area in cross section at right angles to direction of load.

2. The upper and lower surfaces should preferably be ground to true and parallel planes. If this is not done, they should be bedded in plaster of Paris, while in the testing machine, which should be allowed to harden ten minutes under the weight of the crushing planes only before the load is applied.

3. The load should be applied at a uniform rate of increase to the point of rupture.

4. Not less than an average obtained from five tests on five different bricks shall constitute a standard test.

The following resolution was then presented and unanimously adopted:

"Whereas, From the experimental work done so far by this Commission, or by others, so far as is known to us, in the application of the cross breaking and crushing tests to paving bricks, it is not possible to show any close relationship between the qualities necessary for a good paving material and high structural strength as indicated by either of these tests,

"Resolved, That for this reason the Commission recommends that these tests shall be considered as purely optional in the examination of paving material, and not necessary as a proof of excellence."

This report was submitted to the National Brick Makers' Association at its annual meeting held in Buffalo, February 2d, last, by Prof. Orton, together with a synopsis of the data presented to the Commission, and it was unanimously adopted by that Association.

Standard Rattler.—After this action had been taken a new rattler, shown in figure thirty-four, was designed in accordance with the above specifications and installed in the laboratory. The staves were made three-fourths inch thick and the stiffening ribs were not used. The length, size of trunnions, and the speed, were the same as that of the old one, so it was only necessary to remove the twenty-four inch and place the twenty-eight inch barrel in the same bearings. A bell alarm revolution counter has also been attached to a trunnion of the barrel, which can be set to ring when the required number of revolutions have been made.

Removal of Brick Dust.—A source of serious trouble experienced in all the preceding rattler experiments was the dust produced by the wearing of the brick, which, in spite of the extra precautions taken, would float in the air and enter the laboratory, causing great inconvenience. It would take fully half an hour for the dust to settle in the partitioned room, and, in the case of frequent intermittent weighings, a large amount of time would be required. The following method, shown in figure thirty-five, was devised to remove this objection. The back of the box inclosing the barrel was made in funnel form to serve as a collector, and the dust withdrawn by a small exhaust fan with five-inch inlet through a goose-neck pipe and deposited in a pan of water. The immersed end of this pipe is enlarged and serated so that the air readily divides, passing up through the water in small bubbles into a rectangular vessel, from which it is exhausted into the open air. The pipe, pan and vessel were made of galvanized iron. The fan was driven from the main shaft at a speed of three thousand revolutions per minute.

This method of removing the dust was found to give perfect satisfaction. The air was thereafter free from suspended matter, and the closet could be entered without inconvenience at any time, either during or immediately after the completion of a test. The coarse particles passing between the staves remained in the box, but the fine dust was wholly carried away and deposited in water.

Comparison of Rattlers.—The chief object in making the several tests on different kinds of paving brick, given in table six, was to obtain data for the preparation of suitable specifications for use in the Street Department. The new barrel having been adopted, however, the losses obtained in the old barrel could not be used without modification. It was therefore decided to compute the probable losses in the twenty-eight-inch barrel run for eighteen hundred revolutions at thirty per minute, of all the bricks tested in the twenty-four inch barrel from the results of tests in the twenty-four inch rattled for forty minutes at thirty revolutions per minute. A series of characteristic curves was therefore obtained with our standard brick for each barrel, which are shown on figure thirty-six. The five curves from the twenty-four inch barrel almost coincide, while the variation between the four curves from the twenty-eight inch barrel is very small. A comparison of these results with those obtained by Prof. Orton with his standard brick, shows that the range of variation differs between uniform brick of different manufacture, and is probably greater with a chipping than with a wearing brick. The ratio of the average loss in the twenty-eight inch after eighteen hundred revolutions to the average loss in the twenty-four inch barrel after forty minutes' tumbling was found to be 1.73. It was thought that the results of the tests in the twenty-four inch barrel, when multiplied by this number, would approximate closely to the actual losses of the same kinds of brick in the twenty-eight inch barrel. Further tests proved, however, that this factor varies greatly with different bricks, as shown by table seven. The average value, 1.86, was therefore taken as the multiplying factor, from which table eight was prepared. The figures under column two of this table give the probable losses, from which the specifications for brick and block pavements were drawn up by the Board of Public Improvements, an abstract of the first of which is given below.

Extract From Paving Brick Specifications.—"The bricks shall not be less than eight inches nor more than nine inches long, not less than two and one-half inches nor more than three and one-half inches wide, not less than four inches nor more than four and one-half inches deep, with rounded edges with a radius of three-eighths of an inch. Said brick shall be of the kind known as "repressed" brick, and shall be repressed to produce a mass free from internal flaws, cracks, or laminations.

"The bricks shall be uniform in size and quality, and thoroughly burned and annealed.

"All bricks so distorted in burning, or with such prominent kiln marks as to produce an uneven pavement, shall be rejected.

"Each bidder shall submit one hundred bricks, which shall be subjected to such physical tests as may, in the opinion of the Street Commissioner, be necessary to determine their quality and suitability for the work.

"To secure uniformity in bricks of approved manufacture, delivered for use, the following tests shall be made:

"1. They shall show a modulus of rupture in cross breaking of not less than twenty-five hundred pounds per square inch.

"2. Specimen bricks shall be placed in the machine known as a 'Rattler,' twenty-eight inches in diameter, making thirty revolutions per minute. The number of revolutions for a standard test shall be eighteen hundred, and if the loss of weight by abrasion or impact during such test shall exceed thirty per cent. of the original weight of the bricks tested, then the bricks shall be rejected. An official test to be the average of two of the above tests.

"No bid contemplating the use of rejected brick shall be entertained.

"Samples may be submitted by manufacturers, in which case the bidders proposing to use brick of such manufacture will not be required to submit samples. The quality of the brick furnished must conform to the samples presented by the manufacturers and kept in the office of the Street Commissioner.

"The Street Commissioner reserves the right to reject any and all bricks which, in his opinion, do not conform to the above specifications."

The specifications for vitrified block differ from the above only in the following particulars:

Dimensions.—The blocks shall not be less than nine inches nor more than twelve inches long, not less than three and one-half inches nor more than four and one-half inches wide, not less than five inches nor more than six inches deep.

Rattler Test.—When tested in the rattler, under the above conditions, if the loss exceeds twenty-five per cent. of the original weight, then the blocks shall be rejected.

Table nine gives readily the number of bricks required for the standard charge when the volume of one of the samples to be treated has been computed.

Designs have been made for apparatus for the crushing, freezing and other tests, but these experiments have been delayed until the new laboratory is established.

The experience with the twenty-eight inch rattler thus far has not been satisfactory. The cast iron staves suffered from the wear and peining action to such an extent that it was found necessary to replace them with steel staves. This change increased the wear on the brick, and it was found that a loss of thirty per cent. in the rattler with steel staves was equivalent to a loss of but twenty-four per cent. when cast iron staves were used.

The work of conducting the tests on paving brick was done by Mr. F. F. Harrington, of St. Louis, and any value possessed by the results is due to his careful and painstaking method of laboratory work. The duties devolving on myself in the management of the Water Works gave me time for consultation only, and the burden of the experimental work and the records thereof has been borne by him.

TABLE 1.

Fast and Slow Breaking.

	Fast.	Slow.
1	3,020	3,270
2	2,900	2,700
3	2,670	2,760
4	3,520	3,070
5	3,020	2,590
6	2,790	2,330
7	2,730	3,300
8	3,360	2,360
9	2,500	2,330
10	2,340	2,590
Average	2,885	2,730

TABLE 2.

Comparison of Testing Machines.

	Hydraulic Machine.		Riehle Machine.	
	Edgewise.	Flatwise.	Edgewise.	Flatwise.
1	2,730	2,050	2,700	3,600
2	2,670	3,420	3,380	3,170
3	2,760	3,550	2,950	2,310
4	2,310	2,370	1,830	3,240
5	2,450	2,050	2,250	2,230
6	2,710	3,320	2,860	2,270
7	3,330	3,140	2,590	2,590
8	2,870	3,370	2,840	3,130
9	3,440	2,510	3,650	2,920
10	2,640	3,420	2,540	2,450
Average	2,791	2,920	2,759	2,791

TABLE 3.

Effect of Flaws.

	1. Edgewise.	2. Edgewise.
1	1,950	3,230
2	3,130	930*
3	2,140	2,560
4	2,340	2,750
5	2,230	2,520
6	2,010	2,560
7	3,320	1,330*
8	1,100*	3,260
9	1,550*	3,300
10	1,240*	2,260

---

* Fracture shows air-check.

TABLE 4.

Cross Breaking Tests.

		Number Broken.	Average.	Highest.	Lowest.	Per cent. Variation.
1.	Shale	10	2,809	3,500	2,350	40.9
2.	“	10	3,663	4,480	2,900	43.1
3.	“	10	2,791	3,440	2,310	40.5
4.	“	5	3,498	3,940	3,140	22.9
5.	“	10	2,479	2,960	1,920	42.0
6.	“	10	2,617	2,910	2,050	32.9
7.	“	10	2,638	2,780	2,360	15.9
8.	“	10	2,089	2,740	1,470	16.8
9.	“	10	3,096	3,570	2,660	29.4
10.	“	10	3,122	3,910	2,400	48.5
11.	“	10	3,780	4,900	2,610	60.6
12.	Mixture shale and fire clay	10	2,689	2,920	2,320	22.3
13.	“ “ “ “ “	10	2,842	3,250	2,340	32.0
14.	“ “ “ “ “	5	2,670	3,450	2,040	52.8
15.	“ “ “ “ “	10	2,779	3,410	2,220	42.8
16.	Fire clay repressed	10	2.542	3.030	1,970	41.7
16a.	“ “ not repressed	10	2.336	2,730	1.860	37.2

TABLE 5.

Cross Breaking—Edgewise and Flatwise.

		Edgewise.	Flatwise.
1.	Shale	2,791	2,920
2.	“	2,809	3,302
3.	“	3,096	3,196
4.	“	2,482	2,903
5.	“	3,122	3,312
6.	Mixture shale and fire clay	2,842	2,705
7.	Fire clay	2,336	2,413

TABLE 6.

Complete Tests on Paving Brick of Different Manufacture.

		Dimensions.	Rattler.	Absorption.	Specific Gravity.	Cross Breaking.
1.	Shale	8x3¾x3	13.72	1.52	2.41	3,669
2.	“	8x4x2½	14.53	1.15	2.34	3,663
3.	“	8x4x2⅝	11.45	1.17	2.37	3,619
4.	“	8¾x4x2½	12.94	1.83	2.33	3.498
5.	“	8x3¾x2½	18.98	2.05	2.33	2,479
6.	“	8x4x2½	13.34	0.92	2.41	3,780
7.	“	8x4x2½	10.12	1.05	2.36	3,618
8.	“	8x4x2½	12.74	1.85	2.28	2.958
9.	“	9x4x3	10.26	2.48	2.27	3,056
10.	Mixture	9x4x3	9.86	4.09	2.24	2,842
11.	“	9x4x3	11.95	2.86	2.22	2,428
12.	Fire clay	8¼x4x2½	10.87	4.78	2.20	3.221

TABLE 7.

		Dimensions.	1 Per Cent. Loss 24" Rattler Tum. 40 m.	2 Per Cent. Loss 28" Rattler Tum. 1,800 Rev.	3 $\frac{\text{Col. 2}}{\text{Col. 1}}$
1.	Shale	8¼x4x2½	11.29	19.56	1.73
2.	"	8x3¾x3	16.82	27.60	1,64
3.	"	9x4x3	10.26	21.60	2.10
4.	"	8x3¾x2⅝	18.98	34.73	1.83
5.	"	8¼x4x2½	13.64	23.00	1.69
6.	Fire clay	8¼x4x2½	10.86	22.43	2.06
6a.	"	9x4x3	9.64	19.11	1.98
	Average				1.86

TABLE 8.

Comparison of 24-inch and 28-inch Rattlers.

	Paving Brick.	Dimensions.	1 Per Cent. Loss 24" Rattler Tum. 40 m.	2 Col. 1.x1.86	3 Per Cent. Loss 28" Rattler Tum. 1.800 Rev.
1.	Shale	8¾x4x2½	12.94	24.07	
2.	Fire clay	8¼x4x2½	10.87	20.22	22.43
3.	Shale	8¼x4x2½	14.53	27.02	
4.	"	8x4x2½	11.45	21.30	19.56
5.	"	8x4x2½	13.34	24.81	
6.	"	8x4x2½	10.12	18.82	
7.	"	8x3¾x2½	18.98	35.30	34.73
8.	"	8x4x2½	12.74	23.70	
9.	"	8¼x4x2½	13.64	25.37	23.00
10.	"	8x3¾x3½	13.72	25.52	
	Paving Brick.				
1.	(a) Shale	8¾x4x3½	10.80	20.09	
2.	(a) Fireclay	9x4x3	9.64	17.93	19.11
3.	Shale	9x4x3	11.98	22.28	
4.	"	9x4x3½	9.86	18.34	
5.	"	9x4x3	10.26	19.08	21.60
6.	Mixture	9x4x3	11.95	22.22	
7.	"	9x4x3	10.83	20.14	
	Large Paving Block.				
1.	b Shale	9x5x3½	9.83	18.28	

TABLE 9.

Number of Brick for Standard Charge.

Volume.	Number.	Volume.	Number.
71	26	108	17
74	25	115	16
77	25	123	15
80	23	132	14
84	22	142	13
88	21	154	12
92	20	108	11
97	19	185	10
102	18	205	9

The President: I have a communication from Geo. C. E. Meyer; if there is no objection, it will be referred to the Chairman of the Nominating Committee. Next is the report of the Committee on Sewage and Sanitation, by Geo. H. Frost, Plainfield, New Jersey.

"THE PURIFICATION AND DISPOSAL OF SEWAGE."

BY GEO. H. FROST, CHAIRMAN SEWER COMMITTEE, PLAINFIELD, N. J.

To the American Society of Municipal Improvements:

Gentlemen: Your Committee on Sewage and Sanitation begs leave to submit the following report:

Of the 4,000 villages, towns, and cities of the United States, with a population over 1,000, there are about 1,000 which have given more or less attention to the construction of works of sewerage, and these may be classified as follows:

	Combined System.	*Separate System.	Storm.	Total.	Water Works.
N. E. States....	79	60	18	157	381
Middle States...	142	96	25	263	814
S. Atlantic States.	18	20	6	44	156
S. Central States	152	48	58	258	709
N. W. State.....	50	23	26	99	515
S. W. States....	24	29	13	66	252
Pacific States...	22	21	9	52	249
Total........	507	305	160	972	3,196
British America.	35	14	11	60	154
Grand total..	542	319	171	1,032	3,350

These figures are taken from the Manual of American Water-Works, published in May of this year, and the classification, while in the main correct, is not absolutely so, on account of the imperfection of the answers to the blanks sent out for information. Leaving out the storm sewers entirely and making very considerable deductions from the others on acccount of their comparative insignificance, we venture to say that there are in the United States and Canada not more than 400 places, of population of 4,000 and upwards, sewered on the combined system, and of what may be called reasonably complete systems of either class, there are possibly not more than 300 on the North American Continent. It is obvious, therefore, that in the sewerage of American villages, towns and cities there is a vast field practically unworked.

---

*Receiving no storm water.

The problems incident to the collection of sewage in large cities have been elaborately discussed for many years by prominent sanitary engineers of Europe and America, and conclusions have been reached that are generally accepted; it seemed advisable, therefore, to your Committee to make "The Purification and Disposal of Sewage" the subject of this report. But, when your committee began to realize the magnitude of the subject chosen for consideration, the more humbled in spirit they became, their reverence for the many eminent engineers, chemists, and biologists, who have, in the past third of a century, contributed from their original researches in this direction, increasing meanwhile.

The purification and disposal of small quantities of sewage is a comparatively simple problem, especially where land suitable for intermittent filtration or broad irrigation is abundant and cheap. But the great problem is—how to purify and dispose of the volume of sewage of our larger cities—say of 100,000 population and over. And that the sewage of these large cities must eventually be purified before being turned into the rivers or other bodies of water in their vicinity, is clearly portended by the rising tide of public opinion as expressed in the daily journals from the most populous cities of the Northern States.

Our information, based on the published information from about 40 sewage disposal plants in the United States and Canada, mostly located in the smaller towns, is very complete, and the literature descriptive of these systems is easily available. We, therefore, confine our remarks to the discussion of the general problem, rather than a description of completed works.

ENGLISH STUDIES OF STREAM POLLUTION.

Up to about the year 1815 it was a penal offense in England to discharge sewage or other offensive matter into sewers (or drains, as they might be called with more propriety); but by 1847 the value of the "water carriage" system of sewerage had become so well recognized that in London in that year the first act was obtained making it compulsory to drain houses into sewers.

Very naturally, these early combined sewers in London, and elsewhere, had their outlets into the nearest flowing stream or other body of water most available, until the inevitable result of converting these streams or ponds into large open sewers or cesspools occurred, and with the great industrial growth of England this period soon came.

The streams, excepting the Thames below London, and the Mersey at Liverpool, were comparatively insignificant in volume, while the sewage from the growing cities and the large manufacturing districts rapidly increased in volume and offensiveness. This state of affairs called loudly for investigation and reform, and in response thereto the first report of the Health of Towns Commission was made in 1844, and the second report in 1845, each report being published in two octavo volumes.

Mr. Rafter, a well-known American authority on sewage disposal, says: "These two reports may be taken as the beginning of sanitary science in England and in the civilized world generally. They should be studied by any person wishing to compass the whole subject of sewage utilization, by way of showing the magnitude of the evil which has been combated and greatly mitigated since 1844."

The sanitary reform in England from this period onward was very active; the engineering profession paid especial attention to the subject, and the outcome was a succession of commissions appointed to investigate river pollution and sewage purification.

The first Rivers Pollution Committee made their report in five volumes quarto, published in 1866-67. The second Rivers Pollution Commission, appointed in 1868, published their report in ten volumes quarto in 1870-71-72-74.

The Royal Sanitary Commission of 1869 recommended that any stream from which drinking water was taken should be effectually protected from sewage pollution. The first Rivers Pollution Commission point out not only the evils of pollution by house sewage, but also those caused by manufacturing refuse under the following classifications: Chemical works, tanneries, paper mills, woolen and silk works.

The sanitary reforms which have resulted from the labors of these commissions have given to England an acknowledged preëminence as regards sanitary improvements. Whoever has access to the English journal "Engineering" in its earliest volumes, from 1866 to 1880, will find the abstracted reports of the commissions referred to, as well as editorial discussion thereon, and also papers on the subject of sewage utilization and disposal by many eminent English engineers, which were read before various scientific associations. In this connection it is interesting to note that Baldwin Latham, well known to American engineers as a sanitary engineer, advanced the following ideas in a paper read before the Society of Engineers April 9, 1866: "The purification of sewage is due to a very beautiful property possessed by all soils to a greater or less extent, and that is, the affinity the soils have of separating the fertilizing matter from the sewage and holding it until required by the plant."

The important action of bacterial life in the purification of sewage was not then known, nor until after 1880, when the researches of the German savant Koch threw some light upon it.

Note also the authoritative opinion expressed in "Engineering," vol. 1, 1866, page 17, as follows: "A shallow, water-tight slate tray, substituted for the cesspool, and provided with chemical deodorizers, will be the ultimate substitute for water carriage, and the rest of the house sewage may run down the brick tubes into the river without harm." This opinion was in line with the hard-battled-for method of Schwick, at Frankfort-on-Main, who proposed "Emptying the waterclosets into small and accessible water and gas-tight cases, to be carried away daily like so many filled bottles." We recommend these early theories to the especial attention of our Newark, N. J., friends, who are sorely troubled over the pollution of the Passaic River.

Sewage purification and disposal obtained immediate prominence in engineering circles when the new method of purification by "Intermittent Downward Filtration" was brought out by the investigations and report of the second Rivers Pollution Commission. But the apparent wastefulness of this method suggested the superior economical advantages of "Broad Irrigation," by which method not only was the sewage rendered inoffensive, but it was to be made a source of profitable returns upon the investment for land and cultivation.

Show the British investor a fighting chance for realizing an extra good return upon his money and he is prompt to swallow the bait, as witness the innumerable schemes from John Law's time to date which have been floated in the London market. In the utilization of sewage there at once arose in the imaginations of sanguine promoters visions of large and increasing profits from agriculture stimulated into "intense farming" by the manurial virtues of unlimited sewage supplies. With the same rapid fecundity that has, with us, characterized new companies for Klondike exploitation, so in the early 'seventies did the busy British promoter of Sewage Purification and Utilization Companies seek to transfer the hard earned guineas of his thrifty countrymen to his own coffers. As with railroad shares in the time of Hudson, and electric lighting shares of more recent times, so the most extravagant claims for profit from the utilization of city sewage were made, to be afterwards proven as misleading and disastrous as in the crazes mentioned. A standard of purification of the effluent of sewage farms having been established by the government, all sorts of chemical and other "processes" began to be patented as the basis of the claims of the numerous purification companies.

A small volume*. published in 1888, gives a list of 454 patents for the chemical treatment of sewage, from 1846 to 1886. How many have been added to the list to date, we do not know, but in an English municipal engineering journal for July, 1897, we notice advertisements of "Purification of Sewage by Microbes," by "The Sewage and Effluent Water Filtration Co., Ltd.;" "Drying Sewage Sludge," by King's Patent: "Multiple Effect Drying Machine;" a "Polarite and Ferrozone Co.:" a "Magnetite and Aelite Co.," issuing a "Patent Simplicitas Precipitation Tank," and so on through many other processes, showing the continued interest and activity of our English cousins in the subject of this report.

While so many processes for the chemical treatment of sewage have been patented in England, that country has not been without advocates for disposal on land. The discussion between the advocates of each process has at times waxed bitter. Special conditions have often played a most important part in the settlement of individual cases, there being many instances where suitable land could not be found in sufficient quantities to make land disposal alone feasible, while there was at hand no stream or other body of water large enough to receive the partially purified effluent from precipitation works. Consequently chemical precipitation has often been supplemented by land treatment, or some other method of filtration, with good results.

AMERICAN STUDIES OF STREAM POLLUTION.

In our own country the pollution of streams and its remedy began to be seriously considered in Massachusetts in the early 'seventies, Massachusetts then starting the work in which it has so nobly led its sister States for half a century, and in which it has of late led the world.

The history of the Massachusetts studies is given briefly in Rafter & Baker's "Sewage Disposal in the United States."

The results of the more recent investigations, and those which to us of this day are the most important, began to be published in the special report of the Board made in 1890, and have been continued in the yearly reports since that time. Most of these studies relate to intermittent filtration, but much valuable information regarding chemical precipitation is given. Broad irrigation is scarcely touched upon. There is available in Massachusetts so much sandy soil eminently fitted for intermittent filtration, and that process has been found to give such admirable results, that this method has very properly been studied far more than all others.

---

*"Sewage Treatment, Purification, and Utilization," by J. W. Slater, London.

Since Massachusetts began the study of stream pollution a few other States have taken it up, notably Connecticut, New York, New Jersey, and Ohio, the latter having begun its work quite recently, but with commendable vigor and thoroughness.

CONDITIONS GOVERNING SEWAGE PURIFICATION IN AMERICA.

That the streams near almost all of our centers of population, and even in the vicinity of many less populous districts, are being polluted with alarming rapidity, all will admit. If this is true when the provision of sewerage facilities may be said to have only just begun, outside of the larger cities, and when many of the sewers already provided are utilized only in small part, what will be the stream pollution of the future? In passing it may be noted that of 73,000 Ys., or slants, provided for house connections in Cincinnati, O., only 16,000 are in use. Assuming that half of the Ys are opposite vacant lots there would still be only 50 per cent. of the houses on sewers connected with the same.

The problem of sewage disposal assumes greater proportions and far more importance when we consider its relation to public water supply. Increased population and sewerage facilities alike multiply the demands for pure water, at the same time making it more difficult to obtain and conserve.

In the case of any given stream opinions may differ as to whether it should be used as a public water supply or as a sewer outlet, unless it be decided best to purify the sewage before discharging it into the stream. As has often been said, "innocence is better than repentance"; in other words, an absolutely unpolluted supply is better than polluted water subjected to the best practicable system of purification.

But the solution of municipal problems often becomes largely a cold matter of dollars and cents, of possibilities or practicabilities against ideals. Just as a storm sewer cannot always be designed large enough to carry the whole of an extraordinary rainfall, so occasional risks must sometimes be assumed in water supply and sewage disposal practice. A new water supply may be far beyond the means of the city treasury; a new outlet for sewage may be more practicable. Such questions should not be decided upon a narrow, impecunious basis, but with full regard to the effect on the health and personal happiness of the community and the individuals composing it, remembering the value of human life, and that low taxes cannot assuage suffering and grief caused by the ravages of typhoid fever. If it be concluded for any reason that water or sewage purification is more feasible than a new water supply or a new sewer outlet, the next question is, which shall it be?

Here, as before, the various contingencies must be considered with care, including the relative cost of the two possibilities and the probable effect of each on health. The distance between water intake and sewage outlet, the relative volumes of water and sewage, and other factors, must also be considered with care.

As a general proposition, the nearer the purification is to the point of consumption the better, since the chances of subsequent pollution are thereby diminished. In some cases both water and sewage purification may be necessary. Of course, it is understood that wherever sewage can be diverted to a point below the outlet sewer at reasonable expense, this should be done, and that the close proximity of water intakes and outlet sewers will not be tolerated by any good sanitation.

When sewage is diverted from a stream or lake used for a public water supply, or to be discharged in the first instance into a stream not so used, purification may still be necessary owing to the smallness of the volume of water receiving the sewage, the close proximity of the water to houses or manufactories, its use for manufacturing, boating, or bathing purposes. In fact, the majority of sewage purification plants in this country do not discharge their effluent into public water supplies, even at points remote from the intakes, although a number of such plants have been built because sewage had been diverted from drainage areas used for public water supply to streams too small to receive crude sewage, notably South Framingham and Marlborough, in the Boston drainage area.

SEWAGE DISPOSAL BY DILUTION.

It follows from the above that, in general, the chief object of sewage purification is to remove organic matter which otherwise would give rise to offensive decomposition, instead of the removal of disease germs, as in the purification of water supplies polluted with sewage. All surface water, not stagnant nor already overburdened with organic matter of animal or vegetable origin, contains a sufficient amount of available oxygen and organic life to oxidize some of the organic matter present in sewage, but if the proper ratio between water and sewage is not maintained offensive decomposition sets in and a nuisance arises. Sedimentation also plays an important part when sewage is discharged into water. A certain amount of organic matter may be deposited on the stream bed, and gradually decompose without offense, but if the deposit be too large, gases form and rise to the surface as bubbles, and solid matter, partially decomposed, also rises and floats on the surface. Besides this, in times of low water, the sewage deposit, or sludge, is exposed on the banks and a portion of the beds of the stream or other body of water. This last naturally occurs in hot weather, when the deposit, being exposed to the hot sun, adds its contribution to other offensive odors, besides being, like the flocculent matter, extremely offensive to sight.

If the volume of water be large enough in relation to the sewage to supply the necessary oxygen and living organisms for the conversion of the organic matter into mineral compounds, all this offense is avoided, and a water not used for public water supply or extremely delicate processes of manufacture may receive sewage without harm. The action of the oxygen and living organisms, in the case of satisfactory water disposal, upon the organic matter in sewage is similar in principle to the same action in land disposal. It all depends upon the proper dilution of the sewage, and may therefore be termed Disposal by Dilution.

It must not be thought that any valuable constituents of sewage that might be utilized at a profit on land are utterly wasted by disposal into river, lake, or sea. Nature wastes nothing. Just as in broad irrigation the minute forms of vegetable life known as bacteria seize upon the organic matter in the sewage, break it up into its elements and fit it for plant food, so in the water the lower forms of life make possible the utilization by higher forms of the food in the sewage, some of the lower forms being themselves sacrificed in the process on the altar of the economy of Nature. True, the sewage in question may not contribute any of its valuable properties to the community disposing of it, but in the present state of the art, cheap sewage disposal is good sewage disposal, if no one is harmed thereby, and nothing is cheaper than water disposal under favorable circumstances.

The discharge of crude sewage into water, or Disposal by Dilution, under proper conditions is shown by the above to be neither objectionable nor wasteful. It is always to be preferred where possible, but, unfortunately, it is growing less possible as our population becomes denser, so we have to turn to other means of sewage disposal.

THE THREE PRINCIPAL METHODS OF SEWAGE PURIFICATION.

When sewage must be treated before discharging it into water, the type of works to be adopted for a given locality will depend largely upon the character and volume of the crude sewage, and the degree of purity to be attained, and other local conditions affecting the cost of construction and operation of the various kinds of works, such as the price of land, labor, and chemicals, the character of sand or soil available for land disposal, and whether pumping is necessary.

The cost of land and its suitableness for the treatment of sewage are among the most important of the factors named. Near large centers of population land is often so expensive and labor so high as to make land disposal very questionable, if not utterly impracticable, though, when suitable land is available, the proximity of large populations may enable sewage farming to be carried on so successfully as to materially reduce the cost of treating the sewage. More than this cannot be expected from sewage farming in this country at present.

The relative amounts of land required for the processes commonly employed rank from least to greatest in the following order: Chemical precipitation; intermittent filtration, and broad irrigation; but it must be remembered that chemical precipitation alone affords only a partial purification of sewage, sometimes, but not always, sufficient to meet the local requirements.

The insufficiency of chemical precipitation in some cases, the difficulty of getting rid of the sludge incident to the process, and the trouble or expense involved in securing a sufficient area for land disposal, has often led to the combination of the two processes, especially in England. Indeed, in that country cities are often so hard pressed to find suitable land for intermittent filtration, let alone broad irrigation, that a great variety of attempts have been made to improve on chemical precipitation, and to provide some means of artificial filtration at a high rate, either by means of some new filtering material, or by changing the natural conditions inherent to the old.

In this country, also, much time and thought have been given to the same subjects, although the problem is not yet so urgent as in countries with a population denser than ours.'

None of the efforts to increase the degree of purification effected by chemical precipitation have met with marked success, the principal results being improvements in the details and a lowering of the cost of the process. Much the same may be said regarding broad irrigation or sewage farming. It, therefore, has come about that most of the attempts to increase rates of sewage purification methods center around some form of filtration, and recognize the importance of bacterial life. Some of these attempts will be outlined later, after considering the general features and the possibilities of the three established forms of sewage purification, chemical precipitation, intermittent filtration, and broad irrigation.

CHEMICAL PRECIPITATION.

Chemical precipitation may be described as sedimentation hastened and augmented by the use of some chemical which precipitates, or throws down, the suspended matter in the sewage, and at the same time removes or transforms some of the matter in solution. Simple sedimentation removes only matter in suspension, and requires a long time to do that to any extent. The Massachusetts experiments have shown that sedimentation for four hours will remove from 15 per cent. to 30 per cent. of the organic matter, as indicated by albuminoid ammonia. Chemical precipitation, it has been shown by both experiment and practice, will remove some 50 per cent. to 60 per cent. of the organic matter, mostly matter in suspension. Allowing for all contingencies, a tank capacity equal to one-third the daily flow of sewage, may be taken as a safe figure. This allows for tank out of use for cleaning, and for a maximum hourly flow of sewage twice the hourly flow in amount. The sewage generally flows slowly through long narrow tanks, after first receiving some chemical. The clarified liquid is constantly drawn from the top of the tank. The precipitate or sludge sinks to the bottom, and must be removed from time to time. The removal is effected by drawing off the clarified liquid down to the sludge, which is commonly a pasty mass about 90 per cent. water.

The disposal of sludge is one of the most difficult problems connected with sewage disposal. Contrary to the dreams of many, it has but little manurial value, most of the fertilizing material remaining in the sewage in a state of solution. It is sometimes dried, and sometimes pressed, to remove as much moisture as possible, and sometimes dumped at sea. In a few instances the sludge is burned after being dried.

The chemicals most used for chemical precipitation are lime, or lime and sulphate of ammonia combined.

Where a partial purification only is required, chemical precipitation will suffice, but in such cases it should be noted that land treatment at a higher rate than is ordinarily practiced, is also available.

INTERMITTENT FILTRATION AND BROAD IRRIGATION.

Both intermittent filtration and broad irrigation transform rather than remove organic matter, and hence may be made to entirely eliminate the sludge problem. Both processes also depend upon bacterial life for their action, crops being raised in the case of irrigation, the consideration of which, together with the character of the soil, limits the amount of sewage that can be applied, or makes necessary a lower rate of application per acre, and hence more land than is required for intermittent filtration. Different crops, as would be expected, vary in the amount of sewage that they can receive without injury.

The bacteria which play so important a part in land disposal are called nitrifying organisms, because they change the organic matter of sewage from unstable compounds to fixed mineral compounds. In its elementary stage the organic matter existed as albuminoid ammonia. It changes first to so-called free ammonia, then to nitrites, and, finally, to nitrates or nitric acid, when it combines with some mineral base and becomes constant.

In this nitrifying process the sewage partially fills the interstices of the sand or soil, driving out a part of the air, and enveloping the grains of sand or soil with a thin film of sewage. The nitrifying organisms can live only in the presence of oxygen. If a sufficient amount of this remains in the filtering material the bacteria seize upon and break up the organic matter deposited in the thin envelope of sewage about the sand grains, the air assisting in the oxidizing process, as well as enabling the bacteria to live. In the course of time all the oxygen in the pores of the filtering material becomes exhausted. The application of sewage must then be stopped, the bed drained, and allowed to refill with air. The size and shape of the sand grains determines the air space, and this, in turn, the frequency and size of the doses of sewage. All the details of this phase of the subject have been most exhaustively studied at the Lawrence Experiment Station of the Massachusetts State Board of Health, and the results are set forth at length in the reports of that Board, beginning with the year 1890. The effects of temperature, scraping and stirring the upper layer of filter beds, and various other factors, have also been studied and reported on by the Board.

The maximum rate of intermittent filtration, where a very pure effluent is desired, and under the most favorable conditions, is 100,000 gallons per acre per day. Broad irrigation will handle only at a much lower rate.

CROPS ON FILTER BEDS.

In this country crops have been raised on filter beds in a number of instances, and with fair success. All attempts to raise crops in connection with sewage disposal, whether on filter beds or regular broad irrigation areas, are open to the danger that financial returns will be put before sanitary considerations, a thing most strenuously to be resisted. If to this the fact is appreciated that the raising of crops increases the number and skill of the laborers required, and demands a manager who is something of an engineer, chemist, biologist, farmer, and merchant, all in one, and the dangers besetting attempts at sewage farming are seen to be many and various. The temptation under our too prevalent system of city government is to put a sewage disposal plant in the hands of some good party man, without regard to his fitness for the place. It is likely to be considered as rather a nasty job, anyhow, (an entire misapprehension as regards well-managed works), and this idea does not tend to increase the ability of the appointees to the position of manager and assistants. These facts regarding party politics and sewage farms should be considered as obstacles to be removed whenever this method of disposal seems by all means the best one, rather than reasons for adopting some other plan, but when there is considerable doubt as to the best system to adopt, the difficulties named may sometimes be allowed to decide against sewage farming.

It has already been stated that crops are some times raised on filter beds with fair success. This may be taken as a possible point in favor of intermittent filtration, since it renders disposal possible either with or without crops, the area always being ready for filtration when no crops are in hand.

ATTEMPTS TO INCREASE THE RATE OF SEWAGE PURIFICATION.

Alusion was made above to recent attempts to materially diminish the area required for the disposal of sewage, and to eliminate, as far as possible, deposits of organic matter, or sludge on, or in, the beds. Experiments to these ends have been made by the Massachusetts State Board of Health, and by Col. George E. Waring, Jr., M. Inst. C. E., Commissioner of Street Cleaning in New York, in this country, and by several parties in England. I corresponded with Mr. Waring just before I came down here, a couple of weeks ago, and he promised he would add a little to this paper. I have not heard from him since. I just refer to the matter.

The Massachuseets people have directed their attention principally to the removal of organic matter, before beginning filtration proper, trying for this purpose simple sedimentation, chemical precipitation, and rapid filtration, or screening through coarse gravel and coke, the screening being accompanied by forced aeration in the case of the gravel.

The latest published reports pronounce screening through gravel, with forced aeration, followed by ordinary filtration at a rate higher than that usually employed, as a "scientific success," and state that it "perhaps, under favorable conditions, could be used practically." This is very guarded language, and implies grave doubts as to the practicability of the process, after many months of careful study.

Sedimentation and chemical precipitation each make possible a materially higher rate of filtration, but each gives rise to the sludge disposal problem, and is more or less expensive besides. Straining through coke, followed by filtration, seems to have given the most promise of success of any of the methods tried in this connection at Lawrence. The coke, it is thought, could afterwards be used as fuel.

While the Massachusetts experiments with aerated filter or screening beds as a preliminary to filtration, seem to promise but little as yet, Col. Waring in this country, and Mr. Sidney Lowcock in England, claim a distinct advantage in the forced aeration of such beds. Col. Waring has ably set forth the details of his experiments in a pamphlet to be obtained by addressing him at New York, and Mr. Lowcock's process has been well described by himself in the Proceedings of the Institution of Civil Engineers for March, 1894.

On the whole, these various attempts to devise some means to accelerate the rate of filtration, and thus diminish the necessary land area, may be pronounced as worthy of further investigation, but as not yet carried far enough, especially in actual practice, to determine their efficiency and cost, as compared with methods long established and giving well-known results.

In passing, mention may be made of a sewage purification plant at Reading, Pa., put in operation about a year ago, and designed to filter sewage at a very high rate. This plant consists of two beds, one over the other, the sewage falling from the upper to the lower bed in drops.

MR. THOMPSON: What distance apart, Mr. Frost?

MR. FROST: I think they are about 12 feet.

MR. THOMPSON: How many are built?

MR. FROST: Two—one above the other. It is a Philadelphia concern that erected it, and it is quite expensive.

It is claimed that the aeration effected by the dropping of the sewage, coupled with that secured in the beds (which are said to be especially designed to effect aeration, and the double filtration together), render possible a high degree of purification at a very high rate of filtration. The contract capacity of the plant at Reading was 5,000,000 gallons per 24 hours, yet each bed has a total area of only 12,500 sq. ft. ,or less than one-third of an acre.

THE SEPTIC TANK.

One other new method of sewage purification remains to be described. The septic tank process, regarding which much has been written of late, depends upon bacterial action first in a closed dark tank, then in a rapidly working filter. The septic tank attempts to bring into service those bacteria living in the absence of air, termed anaerobic, giving the ordinary aerobic bacteria a chance afterwards in the filter beds, where a high rate of filtration is believed to be rendered possible through the previous reduction of suspended matter. The possibly fatal objection to this process is the fact that a tank capacity sufficient for the entire sewage flow of 24 hours must not only be provided, but the tanks must be so covered as to exclude light and air, greatly increasing the cost. When the sewage has passed through the septic tank it must still be filtered. After all this expensive construction has been provided and the sewage passed through the tank and filters, only a comparatively low degree of purification is obtained, according to the latest information on the subject. An experimental plant of this system, on a working scale, has been in operation at Exeter, England, for some months past, under the direction of Mr. Donald Cameron, City Surveyor of the city named.

PURIFICATION WORKS FOR LARGE CITIES FEASIBLE.

An attempt has been made in the foregoing to present in outline the present status of sewage purification. The growing need for sewage treatment in this country is apparent. Experience has demonstrated that either chemical precipitation or land disposal may be relied upon to do the required work, although chemical precipitation alone will not suffice when a high degree of purification is required.

A number of villages, towns and smaller cities in this country have sewage purification plants in operation. As yet the largest city in the United States that has built such a plant is Worcester, Mass., with a population of about 85,000 in 1890. But, if the smaller cities and towns with their limited resources, can purify their sewage, certainly the great cities, with proportionately larger means, can do so.

The three greatest cities of Europe purify their sewage: London by chemical precipitation; Paris and Berlin by broad irrigation, the latter city having acquired about 20,000 acres for sewage farms, a large part of which is under cultivation. Many other European cities, great and small, purify their sewage. What our smaller municipalities at home, and cities big and little abroad do, certainly our larger American cities can successfully carry out, if they set about it.

In the matter of disposal by dilution, our American cities have already done, or are doing, great things. Boston and surrounding towns have built great trunk sewers and pumping stations for disposal in tide water; Providence, R. I., for years has been engaged in the same work, provision being made for chemical precipitation later on, if necessary; Chicago, as is well known, is spending $30,000,000 on its drainage channel, principally for the disposal of its sewage, and must add millions to this sum before the necessary changes in, and additions to, its street sewerage system will make possible the full benefit of the drainage channel. Other large cities have similar work in hand.

There is no hesitation to expend untold millions for works to discharge crude sewage into water, although a little prophetic insight might reveal to many cities that the future will demand something in addition. The problem is complicated in practically all of our large cities by the fact that combined systems are in use, and that there are many points of outfall on different levels. Probably in most cases heavy storm flows could be discharged at the present outlets without treatment, only the dry weather flow being subjected to purification. Some instances may exist where a separate system would be more economical.

In conclusion, sewage purification on a large scale seems to be a bugbear that most American communities look forward to with a shrinking dread. But it must and will come, and our American Engineers and Boards of Public Works will show themselves equal to the occasion when the critical moment arrives, as they have so often done in the past. (Applause.)

THE PRESIDENT: The next is the report of the Committee on Water Supply. Mr. Keating is on his way here, and has a report to make, but he will not get here until to-morrow noon, I understand. This brings us to the paper on Locating and Removing Sources of Pollution from a Surface Water Supply, by M. R. Sherrerd, of Newark, N. J.

"LOCATING AND REMOVING SOURCES OF POLLUTION FROM A SURFACE WATER SUPPLY."

MORRIS R. SHERRERD, ENGINEER AND SUPERINTENDENT DEPARTMENT WATER, NEWARK N. J.

"The germ theory," as applied to the improvement of water supply, is particularly useful in locating sources of pollution in such a supply when it is obtained from surface drainage.

Until recently analytical examinations were considered sufficient when they embraced a chemical analysis of the water. Now it is essential to determine the kind and number of living things (micro organisms) present in a water as well as its chemical ingredients, in order that the quality may be determined, and its potability established.

To use a chemical analysis to ascertain the presence of pollution in a water supply would necessitate a large number of determinations to first establish the normal condition of a water, while in a bacteriological examination the presence of sewage contamination can be at once made known.

All surface supplies of any considerable size must of necessity be collected from streams which have numerous tributaries, any one of which may be a source of possible pollution.

In treating this subject let us briefly consider the method followed in a case which recently came under the writer's notice.

A systematic bacteriological examination of a water supply made at the point of delivery to the consumers, having shown slight traces of the presence of the bacillus coli communis (thus indicating the probable contamination to a small degree from sewage), a thorough investigation of the water shed was undertaken.

To facilitate the work and also to locate the more dangerous places, samples were taken at the point of intake, at the several impounding reservoirs, just above the junction of all main streams, and at all places where foetal matter was known or suspected to drain into the streams. An inspection of the location of outhouses, barns, etc., was also made. By considering the results obtained from the examination of the water, and the position of the buildings, the location of the dangerous points on a water shed covering many square miles, was soon determined.

The examination of the water of the main streams shows the beneficial effect of aeration in reducing the number of bacteria. As shown below:

At a point on one of the main streams about eleven miles from the intake 37,500 bacteria per cubic centimeter were found, while five miles below this point on the main stream the examination showed 15,890 bacteria per C. C., and at a point three miles below, this stream gave 7,445 bacteria per C. C., and at the head of the intake reservoir, 5,440 bacteria per C. C. were found. From the intake to the distributing reservoirs the water traverses some twenty miles of conduit, and the rapid destruction of bacteria continues.

The water when delivered at the lower end of the conduit does not show over 130 bacteria per C. C., and at times runs as low as 80.

At no point were pathorgenic, or disease producing germs, found, and even the colon baccillus were much reduced in numbers, due to aeration and sedimentation by the time the water reached the consumer.

The presence of the colon baccillus, while not alarming in itself, should, however, be traced to its source and eliminated to prevent the infection of a water supply, which is liable to occur when the small streams receive contamination from disease-producing conditions.

On one of the smaller streams the advantage of bacteriological examination is clearly shown, where in a distance of less than five hundred feet the number of bacteria found varied from 4,240 to 324,360 per C. C., and showed conclusively that the drainage from a considerable number of houses entered the stream between the points where the samples were taken, a condition suspected but not positively known, no indications being present on the surface of the ground to show that this state of affairs existed.

The removal of sources of pollution from a water shed is a more difficult matter and requires stringent measures. The most effectual method is to purchase the property, at least at the more dangerous points, and remove any possibility of drainage from outhouses. The way usually resorted to seems to give the worst results, viz.: to have extreme laws passed for the prevention of pollution and not be able to enforce them.

A more effectual and certainly quicker way would be to undertake the construction of suitable vaults and have them constantly examined and kept in a sanitary condition. If this plan were carried out in a systematic manner, at least for small water sheds, sparsely inhabited, all positively dangerous sources of contamination could be removed.

These few remarks would seem to indicate the importance of constant bacteriological examinations of a water supply, and it is certainly the surest way to know exactly the condition of the water being supplied to a city as regards danger from pathorgenic germs. The conclusion is inevitable that such examinations should constantly and systematically be made, and upon the discovery of any indication of sewage contamination its source should be found and removed.

THE PRESIDENT: We have another paper on this subject: "Filtration of Davenport, Ia., Water Supply," by Mr. E. W. Boynton, commissioner, of Davenport, Ia.

MR. BOYNTON: Mr. President and Gentlemen: I have some photographs showing the work done by the Board I am a member of.

Mr. Boynton passed around to the members of the Society the photographs illustrating the work referred to in his .paper, and then read, as follows:

FILTRATION OF THE DAVENPORT, IOWA, WATER SUPPLY.

BY E. W. BOYNTON, COMMISSIONER PUBLIC WORKS, DAVENPORT, IA.

Gentlemen: The Davenport water works was founded by the Hon. Michael Donahue in 1872, Mr. Donahue serving as president, constructor and manager until his death, October, 1892. While the works did not prove a financial success during his life, his aim to place in Davenport one of the finest and most complete water works systems in the West was crowned with success, and will stand as a monument to his memory.

The Davenport water works system comprises two pumping stations, a filter plant, reservoir, fifty miles of mains, 503 fire hydrants. The maximum pumping capacity of the plant is:

Pumping station No. 1, 11,000,000 gallons daily.
Pumping station No. 2, 7,500,000 gallons daily.
Present total capacity, 18,500,000 daily.

There are now building under contract two additional pumps of 5,000,000 gallons capacity, which will increase the total pumping capacity to 28,000,000 gallons per day. The water supply is taken from the Mississippi River through a tunnel about 2,000 feet long, built under the bed of the river out to the navigable channel.

Pumping station No. 1 comprises the original works and is situated on the Mississippi River, about a mile above the Government bridge. At this station is located the filter house. The filter plant consists of ten double filter shells, each 7½ feet in diameter by 32 feet long, built of mild homogeneous steel of 60,000 pounds tensile strength of five-eighths of an inch in thickness, and stood a proof test of 200 pounds per square inch. The capacity of the filters is 7,500,000 gallons in 24 hours. The filters are so arranged that any one of them can be operated separately or the whole battery collectively. The filters are about three quarters full of sand (originally white sea sand), amounting to about thirty car loads brought from Horn Island, in the Gulf of Mexico. Now another but similar sand from Wisconsin is used.

The water is forced by the pumps through five feet of sand through a peculiar shaped screen, made of extremely fine slits sawed through cylinders of heavy seamless tubing, made of composition metal, thence out into the mains to the city. The process renders the water when taken from the river, even at the highest floods, as bright, clear and sparkling as spring water.

The sediment and other matter which is removed from the water is retained for the time in the filter on the top of the sand, and to remove this quickly and thoroughly with the highest economy and the greatest certainty, is the chief feature of excellence in a filter plant. The method followed during the progress of washing is in the shape of thousands of fine powerful jets, and to apply them directly at the place where the dirt accumulates, and to wash at the same time by reversing the current of water from the bottom of the sand bed. This is accomplished by supplying the water to the filter through horizontal perforated arms attached to a central vertical pipe attached to a piston, and in such a manner that by admitting the water pressure from the mains to this piston the arms are forced downward and back through the filtering material, applying the washing jets each three-sixteenths of an inch in diameter, and under 60 pounds pressure to every grain of sand throwing the whole into violent agitation, thus scouring the sand completely clean, and washing the dirt and sediment off through a drain into the river below the works.

The thoroughness of the work and the rapidity of the operation are such that it requires less than five minutes to wash a filter. Another feature, and by no means an unimportant one, is a process of sterilizing the filter and sand bed by turning into them through pipes connected to the battery of steam boilers powerful jets of superheated steam.

One more important thing and the one that by its use makes mechanical filtration possible is the coagulation and the use of coagulants in the process filtration. By coagulation is meant the addition to the water of certain astringents, notably alum, sulphate of alumina, or perchloride of iron, in sufficient quantities to deprive all of the sediment, no matter how great in amount, or how sticky its nature, and changing it into a lighter flocculent condition, whereby the same can be easily arrested by the sand beds in the filters. Coagulation is accomplished, when necessary, at Davenport by using about three-eighths of a grain of sulphate of alumina per gallon of water. Careful tests show that from 70 to 90 per cent. of the alumina in solution injected into the water before filtration is absorbed by the matter in suspension, forming a coagulated mass on the sand bed, which is washed out when leaving the filters. Albert R. Leeds, Ph. D., Professor of Chemistry, Stevens Institute of Technology, Hoboken, New Jersey, in an address made by him before the Rochester Chamber of Commerce, May 12, 1891: "All natural water contains in solution carbonate of lime, to which its hardness is due; when sulphate of alumina is introduced into the water it is decomposed by the carbonate of lime, and sulphate of lime is formed and hydrate of alumina is set free. It is a perfectly white translucent jelly. It forms on the surface of the filter bed in contact with the grains of sand, and when the smallest particle of silt or the bacteria come in contact with it they are caught by it and held. It is possible to entirely remove the bacteria from water by the use of this jelly."

These filters worked in that manner have been repeatedly tested and that point has been most carefully established. There are some people who think no chemical substitute whatsoever can rightly be employed in the purification of water. If you examine the analysis of river water you will find it contains naturally some alumina; "it is the alumina in the soil which makes the water of driven wells filtered water. It is the alumina in the soil which makes spring water so bright."

And still the company does not cease its efforts to obtain clear and wholesome water, for it has Professor Erastus G. Smith, professor of chemistry, Beloit College, Beloit, Wisconsin, to make a chemical examination twice each month, and he has always found the filtered water in potable condition.

The following from Prof. Smith may be of interest to you, as it shows the work done by our filters.

BELOIT SANITARY LABORATORY.
Erastus G. Smith, Ph. D., Director.

Beloit, Wis., Sept. 30, 1897.

Mr. Boynton, Commissioner Board of Public Works, Davenport, Iowa.

Dear Sir: In reply to your inquiry regarding the quality of the water at Davenport, Iowa, as furnished by the Davenport Water Company, I would state that analyses of the water used and delivered by the company have been made at the laboratory for practically every month since 1892. It has been the aim of such analysis to determine the character of the water as taken from the Mississippi River; and determine what fluctuations, if any, it was subject to, and how the same could be most efficiently treated to deliver as good a grade of water as possible to the citizens and consumers. Since 1892, when the first analyses were made, chemical analyses have been made quite regularly and reports on same submitted, and on such analyses the operation of the filters has been practically based.

Regarding the raw waters of the Mississippi River, I would say that they vary in character from a water nearly clear and of fair quality to a water muddy, loaded with silt, carrying the sewagic materials washed in by deluging local storms from the cities along the banks, and during periods of the year, notably the late spring and early summer months, stained with a water swept out from the cedar swamps, or from the logs and vegetable debris carried by the stream. Such a water is exceedingly difficult to handle and at times defies all attempts at purification. During each year in every month except the month of June the limits of impurity, as yet by our best authorities as permissible for good and acceptable waters, have been much higher than results obtained. During June the waters receive the deep "log-juice" stain alluded to above and the data then approach more nearly such limits. Whether this has any special sanitary significance is fairly a matter of doubt. Take, for example, the year 1896, and the single determination of albuminoid ammonia which probably is as significant a factor as any single one in estimating the character of the pollution of a stream, and from my notebooks take the following data of the successive monthly samples, the figures indicating *parts per million of water.*

Month.	Raw Water.	Filtered Water.
January	.06	.04
February	.40	.10
March	.28	.05
April	.50	.09
May	.60	.10
July 8	.28	.16
July 31	.60	.08
September	.31	.14
October	.20	.09
December	.35	.12

Any person conversant with such data will observe at once the serious character of the water at times and the marked improvement in the filtered water and especially *the uniformity* of the same. It would be interesting to extend this comparison to other data, as the solids, the free ammonia, the oxygen consumption of the water, and we would find a very similar result. During single years, and comparing year and year, we have been surprised to see the uniformly good results of the action of the filters from the chemical stand-point.

The development of sanitary science has demanded the investigation of filter efficiency from the biological stand-point. Some bacteriological work has been done already at the suggestion of the management of the company. Some such investigations were made during December, 1896, and the early part of this year, and I take pleasure in giving you some results from my note-book:

	No. of Bacteria per C. C. of Water on Gelatine.	
	Raw Mississippi River Water.	Same Filtered.
December 6, 1896	4,000	83
February 3, 1897	680	48
April 8, 1897	3,500	34
May 14, 1897	384	32

Of such of these bacteria as grow at bodily temperature, and therefore more presumably of sewagic character, I would note:

	No. of Bacteria on Agar-Agar at 37° C.	
	Raw Mississippi River Water.	Same Filtered.
December 6, 1896	12	0
February 3, 1897	9	0
April 8, 1897	65	0

These results are exceedingly interesting and suggestive, and important in estimating the efficiency of a system of filtration. Owing to the repairs now being made to the station at Davenport and my absence from Beloit abroad during the whole summer, both chemical and bacteriological work has been momentarily interrupted, but will be resumed at once.

Hoping above answers fully your inquiry, it is,

Respectfully submitted,

ERASTUS G. SMITH.

Since the filter plant has been in use, there has been a great reduction in the number of cases of typhoid fever. Many of these cases in the last few years have been caused by the use of well-water, and only a very few cases in which filtered water has been used.

The following is a list of the typhoid and typho-malarial fever cases.

In 1888 there were seven cases.

In 1889 there were fourteen cases.

In 1890 there were fourteen cases.

In 1891 there were seven cases.

In 1892 there were four cases.

In 1893 there were ten cases.

In 1894 there were five cases.
In 1895 there were eight cases.
In 1896 there were three cases.
In 1897 there were two cases.

In the year 1893 three cases, and 1896 two cases were brought to our hospital from outside the State.

So that in 1893 we had seven cases.

In 1896 we had one case from the city of Davenport.

To what extent the introduction of pure filtered water has also limited the prevalence of diptheria, and other diseases that riot in filth, we can perhaps guess blindly at best, but we are well assured of the great efficacy of our filters as a prophylactic in these maladies. What we do know, is this, we can open a faucet anywhere in Davenport and show from it a stream of clear crystal water, as bright as any that flows from the mountain snows, and that we have solved the question of water purification. It has cost thousands of dollars to accomplish this, and there has been no increase in the rate, by way of compensating the company for this large outlay.

Its customers are steadily increasing and it is regarded with sentiments of friendly affection that do not exist on the part of any city in this region towards any other water company. I am indebted to the kindness of the Davenport Water Company, and especially to the able secretary, Col. J. P. Donahue, for the photographs, and the information contained in this paper.

THE PRESIDENT: Mr. Sherrerd has another short paper on this same subject; I understand it is brief.

MR. SHERRERD: At the last meeting of the New England Water Works Association, Mr. Hawley, Supt. at Atlantic City, gave a talk on the introduction of meters at Atlantic City, which was one of the best, as I understood, of that convention. I wrote Mr. Hawley, asking him if he would not put that subject in shape for this meeting. He has given a short paper here, which I thought would be interesting, and with your permission I will read it.

(Presented and read at the Nashville meeting of the American Society of Municipal Improvements, by M. R. Sherrerd.)

THE RESULTS OF THE INTRODUCTION OF WATER METERS AT ATLANTIC CITY, N. J.

BY W. C. HAWLEY, C. E., SUPT. WATER DEP'T, ATLANTIC CITY, N. J.

Atlantic City is located on a long narrow sandy island, no part of which has an elevation of more than 12 or 15 feet above high tide. Its population ranges from a resident population of 21,000, in winter, to over 175,000, some days in summer. There is no manufacturing, but there are more than 500 hotels and large boarding houses, and about 200 more smaller boarding houses. There is a system of sanitary sewers; storm water being carried off in the gutters.

Previous to 1893, there had been two water companies supplying the city with water. Competition had nearly ruined both financially, and the result was a combination, which existed until August 1st, 1895, when the city purchased both plants, which it has since operated.

During the period of competition between the two companies, waste was encouraged rather than prevented, and thus the consumers in many cases came to regard outrageous waste as perfectly legitimate use of water. Many of the cheaper class of houses were on piles or stilts, with pipes exposed underneath, and a few days of cold weather would cause an increased pumpage amounting from 10 per cent. to 30 per cent. of the normal. Hopper closets were in common use, and the plumbing in a large portion of the less expensive buildings was of the poorest sort. Some meters had been used, but a large bill by meter measurement was frequently the reason for the removal of the meter, instead of the stoppage of the waste. The consolidation of the two companies made little change, as the prospect of purchase by the city was sufficient to defer all improvements.

When, on August 1st, 1895, the city took possession of the works, it was impossible to maintain a pressure of over 20 to 25 pounds during much of the summer season, and the plants were being operated actually up to their limits. The consumption per capita ranged from 200 to over 250 gallons per day. Parts of the city had either no water mains at all, or else those in place were so small as to furnish but little supply. A large amount of pipe was needed in these districts, and when this was laid, more water would be needed to supply them. The problem confronting the city was either to reduce the enormous waste, or else to provide an additional supply of water, with new pumping plant and mains, at an estimated cost of at least $250,000, with the additional cost of operating and maintaining.

Mr. George T. Prince, Mem. A. S. C. E., who was appointed superintendent when the city purchased the works, recommended the general introduction of water meters, and certain extensions of the pipe system.

After consulting with Mr. Clemens Herschel, Mem. A. S. C. E., it was decided to spend $75,000 at once on extensions to the pipe system, and about 16 miles of new distribution mains were laid. To spend $25,000 in purchasing and setting water meters; and to defer the expenditure of $250,000 for a new supply, pumps, force main, etc., until the results of the introduction of meters should be known.

The writer was appointed superintendent to succeed Mr. Prince, March 1st, 1896, just as the first of the meters were set. There were, at that time, about 300 meters in service (many of them old rotary meters, worn out and practically worthless), on a total of 3,095 taps. On August 1st, 1896, there were 1,916 meters in service on a total of 3,446 taps. August 1st, 1897, there were 2,135 meters in service on a total of 3,692 taps. The results are shown in the accompanying diagram. Fig. 1, which represents a comparison of the pumpage profiles for the years 1890-97 inclusive. It is probable that about 10 per cent. of the reduction in pumpage shown is due to improved condition of pumping machinery and a slightly larger percentage for slip than was formerly allowed. Note should be taken of the fact that on August 1st, 1895, the number of services was 3,095. On August 1st, 1897, the number of services had increased to 3,692, or 19.3 per cent. In spite of this and almost entirely because of the prevention of waste, the pumpage shows a very marked reduction. It is true that during this period five of the larger hotels put down artesian wells for their own supply, but the total reduction in pumpage on this account would not exceed 100,000 gallons per day, and the reduction in pumpage in August, 1897, over August, 1895, was 2,700,000 gallons per day. The average number of gallons pumped per tap per day in August, 1895, was 2,500. In August, 1896, this was reduced to 1,775 gallons, and in August, 1897, to 1,350 gallons, or a reduction of 46 per cent. from August, 1895. This reduction in pumpage enabled the ordinary pressure of 35 to 40 pounds to be maintained during the summer months, which had not been done before in several years, and this in spite of the large increase in the pipe system and the consequent additional consumption.

The immediate result of the introduction of meters was to defer for some years the necessity for expending for additional supply the $250,000 contemplated, thus saving the additional interest and sinking-fund charges, amounting to at least $16,250 per year. This saving alone in less than four (4) years will buy and set a meter on every service in the city, and this allows nothing for the saving in the extra labor, salaries, etc., for operating the enlarged plant.

A decided saving in coal consumed is also shown, due, as before explained, to the reduction of pumpage caused by the meters.

Comparing the coal used for the year August 1st, 1894, to August 1st, 1895, with that used from August 1st, 1896, to August 1st, 1897, there is found a total saving of 2,500 pounds (1.115 gross tons) per day, which at $3.co per ton, the cost of the coal in bin, is worth $3.34½ per day, or $1,220.93 per year. To this add one-sixth as much to allow for coal consumed at the "Consumers'" pumping station, and the total saving is $1,424.41. The interest on the cost of these meters (including cost of setting) is $1,125.00 per year, so that the saving in fuel alone exceeds the interest on the cost of the meters by $299.41.

It has been shown that the number of taps increased from August 1st, 1895, to August 1st, 1897, 19.3 per cent. Had it not been for the introduction of the meter system it is reasonable to suppose that the additional fuel needed would have been at least an equal percentage, admitting for the moment that the increased pumpage was within the capacities of the plants, which it was not. This increase would have amounted to $1,244.28 per year, to which add $299.41 (the saving per year already shown in fuel over interest) and the sum, $1,543.69, is more than enough to pay the cost of maintenance and care of the meters, which cost is about $1,400.00. This calculation has taken no account of the additional revenue received from the 597 new services, which is easily $10.000 per year. This increase is probably offset, however, by the decrease in revenue due to the very general saving on the meter rate compared with the former high assessed rate. This reduction of bills has made the meters quite popular, though there is occasionally heard the wail of some one who did not have repairs made when he should.

It becomes evident, therefore, that, considered solely as a cold-blooded business proposition, not taking into account the equity, justice and other good reasons for its introduction, the meter system in Atlantic City has proven a success. One thousand new meters are now being set and it is the intention to ultimately meter every service. City Council has decided to raise by direct taxation a sufficient sum each year to pay the Water Department for the water used for fire protection, street sprinkling and other public uses, thus making all property pay directly for these services, in addition to the payment for the water actually used on the premises, and allowing a lower meter rate than would otherwise be possible. The rates previous to August 1st, 1897, were 18 and 14 cents per thousand gallons. The rate is now 12 cents per thousand gallons.

The results of the introduction of water meters in Atlantic City have probably been as pronounced and satisfactory as those obtained in any other city in this country. A few years ago the value and desirability of the meter system were very frequently questioned. To-day no one of intelligence and sincerity opposes it: that is left to the political demagogue who is always ready to pose as the champion of the poor man, and the political boodler, who can see more "stuff" in an expenditure for pumps, mains, reservoirs, etc., amounting to hundreds of thousands of dollars, than he can in the purchase of a few thousand dollars' worth of meters.

The stock arguments against the meter system, "that the poor would economize to such an extent that filth, unsanitary conditions and disease would result," "that people could not afford to pay for water by measurement," "that meters are inaccurate," etc., etc., have all been proven false time and again. The meter works no hardship on any class of citizens; it treats all alike. A proper minimum rate, allowing a reasonable quantity of water to be used, solves the problem; and he who uses or wastes more should in all fairness pay for it at a rate which reimburses the city for furnishing it. "Water should be as free as air," we are told. True; but that is no reason for waste. It takes fuel, salaries, interest, sinking-fund charges, etc., to deliver water to the consumer, and these are what are charged for, not the water. A man should pay for what he uses and there is no more reason why two houses of equal size, one with a family of three in it, and the other with a family of ten, should pay the same for water (as they would on an assessed rate), than there is that the grocery bills for the two houses should be equal.

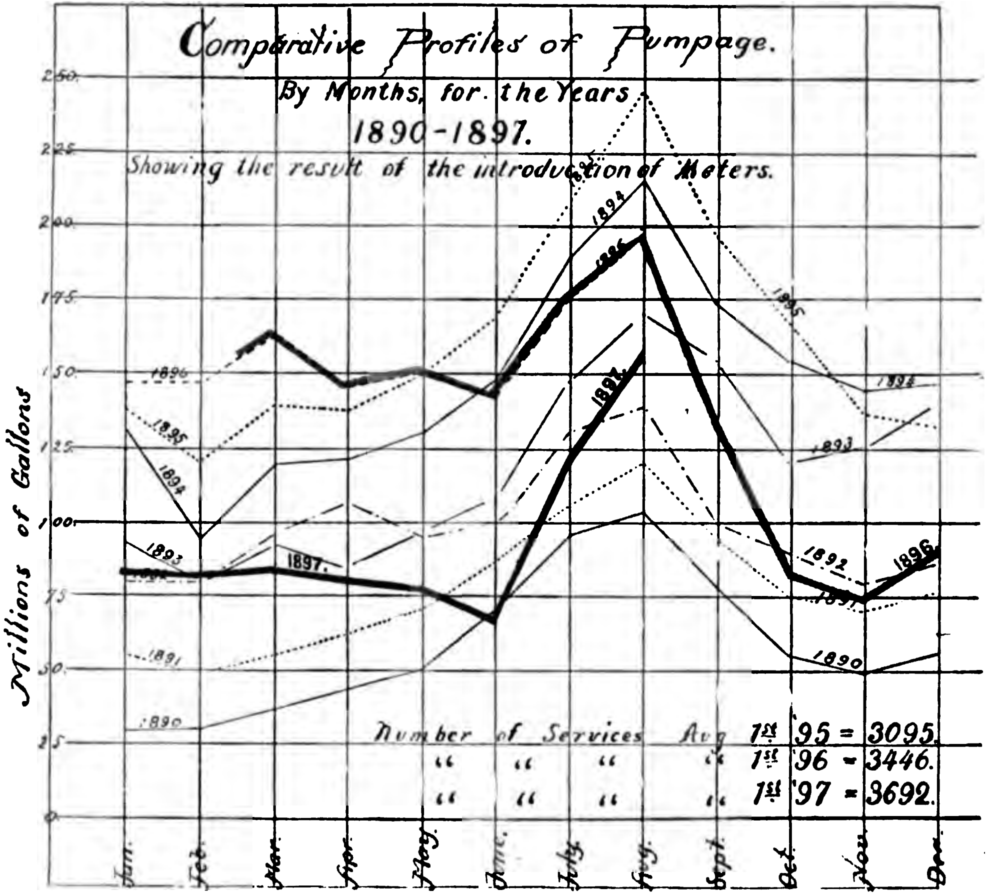
It has been amply demonstrated that the meter is the only efficient means of reducing waste to a minimum. A plumber is sent for instantly when a leak is found on a service that is metered. He is probably not sent for at all if there is no meter, unless damage or inconvenience is caused.

The important result of the meter system is the decreased per capita pumpage, thus making a given plant supply the largest possible number of consumers. There are many waterworks in the United States to-day working up to or near their limits, with per capita pumpages ranging from 120 to 200 gallons per day. The question in such a case is simply whether it is advisable to spend some thousands of dollars for meters, or as many hundreds of thousands of dollars for extensions and new supplies.

THE PRESIDENT: Gentlemen, before proceeding with the election of officers for the ensuing year, I desire to announce that the Nashville Street Railway Company has tendered us the use of all the necessary cars to convey the entire party, including the ladies, to the exposition, at 2:30 this afternoon.

Fig. 2.

THE WATER DEPT. OF ATLANTIC CITY.



THE NEW YORK
PUBLIC LIBRARY

ASTOR, LENOX AND
TILDEN FOUNDATIONS

The cars will be here in front of the hotel, and will leave promptly at 2.35.

We come now to the election of officers for the ensuing year. Is the Committee on Nominations ready to report?

MR. BENZENBERG: The committee appointed for the purpose of nominating officers of this Society for the ensuing year has directed me to make the following report, as their recommendation and nomination for officers for the ensuing year:

President: Mr. Harrison Van Duyne, of Newark, N. J.
First Vice-President: L. W. Rundlett, St. Paul, Minn.
Second Vice-President: E. H. Keating, Toronto, Ont.
Third Vice-President: A. D. Thompson, Peoria, Ill.
Secretary: D. L. Fulton, Allegheny, Pa.
Treasurer: J. L. Kennedy, Nashville, Tenn.
Finance Committee: F. J. O'Brien, Oswego, N. Y.; H. J. Stanley, Cincinnati, Ohio; E. W. Boynton, Davenport, Ia.

THE PRESIDENT: You have heard the recommendation of the Nominating Committee. Further nominations are now in order.

It was moved that the recommendation of the committee be adopted, and that the Secretary be instructed to cast the ballot of the association for the respective officers therein named.

Motion seconded and carried.

THE SECRETARY: Mr. President, and members of the Society: I hereby cast this ballot as the official act of the Society.

THE PRESIDENT: In accordance with your directions the Secretary has cast the ballot as follows:

President: Harrison Van Duyne, Newark, N. J.
First Vice-President: L. W. Rundlett, St. Paul, Minn.
Second Vice-President: E. H. Keating, Toronto, Ont.
Third Vice-President: A. D. Thompson, Peoria, Ill.
Secretary: D. L. Fulton, Allegheny, Pa.
Treasurer: J. L. Kennedy, Nashville, Tenn.
Finance Committee: F. J. O'Brien, Oswego, N. Y.; H. J. Stanley, Cincinnati, O., and E. W. Boynton, Davenport, Ia.

And I now declare these gentlemen elected as your officers for the coming year. (Applause.)

MR. VAN DUYNE: Mr. President, and Gentlemen of the American Society of Municipal Improvements: I heartily and sincerely thank you for the honor that you have done me in choosing me as your presiding officer—not only for myself, but for the compliment that you do the city which I have the honor, with my fellow-commissioners, of representing here in this body. I will only say, at this time, that the authorities of the city of Newark, in their desire to obtain the best results from the great amount of work they are now doing to improve their city, have favored this association, representing the different cities of the country, and have believed that only good results could follow from thus coming together once a year and comparing notes, not only giving our successes, but also giving the failures that we may have had, so that other cities may profit by them—by following our successes and by avoiding our failures. Gentlemen, I will not detain you at this time. I again heartily thank you for the honor you have done my city and myself. (Applause.)

THE PRESIDENT: Mr. Rundlett is not in the room; Mr. Keating has not got here yet; Mr. Thompson: Mr. Fulton—do you want to hear from Mr. Fulton or Mr. Kennedy?

MR. FULTON: Mr. President, I make a motion that the Secretary's speech be dispensed with. (Laughter.)

THE PRESIDENT: The next thing in order is the report of the Committee on the Next Place of Meeting. Is that committee ready to report?

Mr. Sherrerd here arose and read the report of the Committee on Place of Meeting, as follows:

THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS, NASHVILLE, TENN., MEETING OCT. 6TH, 1897.

Your Committee on Place of Meeting for the next convention, having considered the several invitations, and carefully canvassed the question, find that all the positive invitations received come from the

West or middle West, and believing it would be a benefit to the Society that the next convention should be held in the eastern part of the country, and feeling assured that the committee will be sustained in its conviction that this Society is sufficiently strong to choose its own place of meeting irrespective of invitation, have decided to recommend that Washington, D. C., be selected as the place for holding the next annual convention.

Its central location, its prominence as the National capitol, the numerous points of interest in its vicinity, and its many interesting and excellent municipal improvements, all suggest the advisability of meeting at this point.

Your committee is informed that while on account of the peculiar methods of government (no funds being in the possession of the commissioners, except such as have been appropriated by Congress for specific purposes), the municipal officers in charge did not feel justified in extending the invitation to the Society to meet at this point, still, your committee is assured that they would be glad to have us select their city as the meeting-place for our next convention.

Respectfully submitted.
M. R. SHERRERD,
ANDREW ROSEWATER,
GEO. W. TILLSON,
H. J. STANLEY,
W. J. STAINSBY,
D. L. FULTON.

THE PRESIDENT: You have heard the reading of the report on the Next Place of Meeting. What is the pleasure of the convention?

On motion of Mr. Boynton, the report was adopted.

MR. BENZENBERG: Mr. President, the Executive Committee in its report yesterday submitted several amendments to the constitution, including them all in one section and article, and under the by-laws they must be acted upon at this time, having been submitted in writing on the first day of the meeting of this Society. I move that we take up the matter.

THE PRESIDENT: It is an amendment to Article IV, of the constitution. It provides for an additional committee, to be known as the Committee on Municipal Franchise; and the amendment further provides, speaking of the duties of special and standing committees, that none of them shall be authorized to make any expenditures unless the same have been first approved and authorized by the Executive Committee. That is the sum and substance of the amendment.

MR. KENNEDY, Nashville, Tenn.: I move you that it be adopted. This motion, being seconded and put, was carried.

MR. SHERRERD: In connection with the report of the committee about the place of meeting, I am glad to mention that we had a very cordial invitation from Omaha, from the Commercial Club, and I would like the request answered on behalf of the Society, thanking them for the invitation, and stating why we decided to go East.

THE PRESIDENT: I would suggest again, that after our adjournment to-day, those members who have not yet consulted the Secretary please do so. The Secretary has also a number of our certificates that we had printed last year; it may be possible, some of the members have not as yet obtained them.

On motion the convention adjourned until Thursday morning.

THURSDAY, OCTOBER 7th, 1897. MORNING.

August Herrmann, president, in the Chair.

The meeting was called to order at 10:10 a. m.

THE PRESIDENT: We will now hear the report of the Committee on Waterworks and Water Supply.

MR. E. H. KEATING, Toronto, Ont.: I will say, Mr. Chairman, that the committee has been corresponding with one another on the subject, and comparing notes, and we had arranged to be here prior to the meeting of the Society, and, unfortunately, I was delayed in Toronto for about a day, and we were further delayed on the railroad by this railway accident, and we have been unable to get together at all. I hope to meet the committee or one of the members of it here, and see if we cannot put our report in shape, perhaps, by to-morrow morning.

THE PRESIDENT: The first thing on the programme for this morning is the report of the Committee on Disposition of Garbage and Street Cleaning, Dr. J. L. Hess, of Cleveland:

MR. PRESIDENT AND GENTLEMEN OF THE CONVENTION:

I desire to briefly give you the benefit of my observations on a recent tour of inspection of the garbage plants of several of the cities in the East and South.

On the fifth day of November, 1896, in company with several of the city councilmen and one of our most reputable citizens, I went to the following-named cities, with a view to ascertain the manner in which they collected and disposed of their garbage and other refuse, and to determine to what degree of satisfaction the work was being performed.

The first city visited was Buffalo, which city collects its garbage under municipal control. The disposal plant, which is a Merz Reduction System, is owned and operated by a private company. The plant is located just outside the city limits; the garbage and other refuse matter is hauled there by wagons and disposed of by reducing it to a fertilizing material and extracting the grease. The manner in which the garbage was handled at the works, in the judgment of our committee, was that it was one of the most unsanitary and filthy places that could be conceived of, on account of the fact that the garbage was dumped in an open box or chute and handled several times before being finally disposed of.

Philadelphia has a reduction plant known as the Arnold System. At this particular plant the manner of handling the refuse was a trifle better than at Buffalo, the garbage being dumped from the wagons on an open platform from which it is shoveled into conveyors, which are open, the garbage being carried a distance of 100 or 125 feet and dropped into boiling tanks, where it is boiled for a period of from two to four hours, after which it is drawn out of these tanks in a liquid nature and placed into bagging, which is placed on a car eight or ten layers deep, after which it is placed under a large power screw press, where the liquids are squeezed out of the garbage. After this operation the residue is taken into another room and placed in driers where the remaining moisture is dried out and the residue comes out in the form of a dried material, to be used as a fertilizing base.

Washington, D. C., has a crematory furnace, which is located in the suburbs of the city, next to a soap factory, or some such works, which threw off disagreeable odors to such an extent that our committee were unable to determine whether the crematory produced any offensive odors or not, as it was quite natural that the people at the crematory would blame their neighbors for producing all of the stench that was noticeable and claimed for their plant a system free from objections.

Atlanta, Ga., also have a crematory known as the Dixon Sanitary System. This plant is located outside of the city limits and disposes of the bulk of the garbage and night soil of the city. The plant is located on a piece of ground which adjoins a field, in which they bury a large amount of night soil. During the time we were making our observations of the workings of this plant, I am free to confess that we did not discover much odor, but on making inquiry from a number of people, they stated that at certain hours of the day the odor from the place is almost unbearable. On questioning the proprietors or officers in charge of the plant concerning the above statements, they informed us that the stench arose wholly from the field in which the night soil is buried. So that our observations in connection with the crematories was not satisfactory. It seems to be a coincident that these crematories are located contiguous to some place of an extremely offensive character, to which any blame could be attached, should complaint be made of offensiveness.

At Bridgeport, Conn., they have a reduction plant in operation known as the Holthaus System. This is the only plant that our committee saw which they felt could consistently be called a sanitary system, in so far as being absolutely free from offensive odors is concerned. At this plant the garbage is dumped from a wagon into a little car. The car is elevated to the level of the top floor of the building, where it is dumped directly into the boiling tanks, from which time the garbage is not seen again until it comes out in the form of a finished product, such as oil or grease and a dried fertilizing base.

The general appearance of the plant is cleanly, free from any sloppy condition and no odor whatever except in the room where they keep the dried garbage, where a sweet odor is noticeable, which may be likened unto the smell of licorice. The objections raised to this plant by some of our committee is that the internal workings of the system could not be observed and that they, the committee, were not quite sure that the internal workings of the system would be satisfactory. To my mind this is the very feature of the system which was to be commended for the reason that it is the intermediate exposure of the garbage in the Merz and Arnold Systems which make them objectionable by reason of the large quantity of the liquids which is spilled about the works and the large volume of steam which is very objectionable in odor that is thrown off from the hot garbage. This objectionable feature is obviated in the Holthaus System by the work being performed continuously. After the boiling is completed, the excess of moisture and grease is pressed out of the garbage while remaining in the tanks by a hydraulic cylinder and plunger, which is connected with the boiling tanks. The liquid is conducted by pipe lines to a large covered tank, where the oil is skimmed from the water by an automatic arrangement and conducted into another tank, from which it is drawn into barrels ready for shipment. The water that is remaining is carried to evaporators by pipe lines, and is disposed of by evaporation, so that the whole process of garbage disposal is carried on from the time that it is received into the works without any intermediate exposure until it comes out in the form of a finished product, as fertilizing base and grease, ready to be shipped.

After looking over all the various systems of garbage disposal, our committee were unanimous in the opinion that the Holthaus System was the one which gave the most satisfactory results. It is possible that the Dixon System may be made to perform the work in a commendable and satisfactory manner, but in considering the question of garbage disposal, the first consideration should be, which is the most sanitary; next, economy.

My observations have been that the Holthaus System of garbage disposal is equally as sanitary in its method of disposition of garbage as the Dixon System of cremation by reason of the fact that the work is performed without any offensive odor and the finished products of the plant are free from anything or substance which is objectionable or offensive or unsanitary.

The products of the reduction systems have a commercial value which makes the system partially self-sustaining. This was manifest recently in the city of Cleveland, which city advertised for proposals for the disposition of its garbage and night soil. The lowest proposition received, in accordance with the advertisement for the collection and disposition of garbage and night soil in bulk by the reduction method on a five-year contract, was $120,000 per annum. The lowest proposal received for the collection, removal and destruction of garbage and night soil, in bulk, by cremation, was $140,000 per annum, showing a net saving by the reduction method, over cremation, of $20,000 per annum.

Therefore, after considering this question from a sanitary and financial standpoint, it is my judgment that the reduction method of garbage disposal meets all the requirements, both from a sanitary and economical standpoint.

Mr. Rosewater: I would like to ask the gentleman before he closes, do you include stable manure as garbage?

Dr. Hess: We do not.

Mr. Rosewater: Then that is disposed of entirely separately?

Dr. Hess: I might state that in our city we are surrounded by a large farming district, and the manure from the stables is eagerly sought for by the farmers, so that it is not necessary for us to give that any consideration aside from requiring that it shall be removed in the time required by ordinance, which makes it imperative that all manure boxes shall be emptied every 72 hours. Street sweepings is not included in garbage, it is taken care of by our Public Works Department. Garbage, as we understand it, is table and kitchen offal, and such material as will be collected from restaurants, butcher-shops, slaughter houses, game establishments, and the like. Refuse matter taken from such places is included in garbage.

Mr. Rosewater: I would like to ask if the committee obtained the cost of the Bridgport method?

Dr. Hess: I understood the requirements of the Chairman of the committee, of which I am a member, was to get up a tabulated report, in connection with the various questions of interest pertaining to the cost of the construction of garbage plants, population of cities, etc. This report I submitted, after our investigation a year ago, and in talking over the question with some of our representatives, they considered it would probably be better for me to read a paper on garbage disposal before the Society and submit the report I had made pertaining to the cost of the plants from various cities, their population, and the estimated return from residuals; I have that report here in tabulated form, and I will give it to you. First, my recollection is, the cost of the Bridgeport plant was $70,000, population 60,000. The plant was estimated to dispose of 80 tons per day of 24 hours, and they collect about from 20 to 25 tons of garbage per day, so that the plant is entirely too large for the amount of garbage to be disposed of.

Arthur R. Reynolds, M. D., Commissioner of Health, Chicago: I am very much indebted to the essayist for the paper just read concerning the disposition of garbage. One of the first difficulties to be overcome in disposing of garbage, no matter whether it be reduced or cremated, is the odor that arises from the accumulation of any considerable amount of garbage at any one point.

This nuisance is found at crematories, as well as at reduction plants. It has been demonstrated again and again in this country, that garbage contains a utilizable product of grease and fertilizer of considerable value, and the process of obtaining these products is called the reduction process. The reduction process has this advantage over cremation.

We have recently heard from Buffalo of a scheme whereby fourteen thousand (14,000) cubic feet of gas is made out of a ton of garbage, by the addition of chemicals and the application of heat, at a cost of 10 cents per thousand feet. We have also heard much through the daily press of Lord Kelvin's plan, in use at Shoreditch, London, whereby the garbage is coked and used for fuel. Whether these plans are Utopian or not I do not know.

The question of proper disposal of garbage is still in process of evolution, great advancement having been made in the last few years.

Mr. Rosewater: It strikes me that whilst the general theories laid down by the committee, that the sanitary—from a sanitary standpoint—is the primary, the main standpoint to be considered; the method referred to as the best, the Holthaus system, still leaves a wide gap before we can fully come to any conclusions upon this subject. We know very well that for years the theory has been advocated, that the disposal of sewage itself through sewage farms and other methods, from a standpoint of economy ought to be utilized, but experience has demonstrated, at least so far, that the disposal of sewage for the purpose of making money, or gain, has been a failure; in other words, here up to this time, as I understand it, the most economical method is the best method of disposal—not for the purpose of making any revenue. Now, in the absence of any figures, as a rule, the cost of the plants, from which we can determine what it cost to maintain them, and what the interest on the plant is, we can not come to any conclusions, at least we would not be warranted in any conclusions, because we do not know how much each of these plants is going to cost to be maintained, and the difference of $20,000 in a bid in a year for the disposal of garbage in the city of Cleveland—that is, $120,000, as I understand, and $140,000—would not be a basis sufficient to warrant the conclusion, as we do not know what interest or what percentage of profit these bidders have figured upon, consequently, we do not know what the cost of their plants are, nor what the cost of maintenance is. It certainly would be a very desirable thing if we could get these results through such a system as that, that would utilize the material and do it cheaper, but, I think, the importance of the subject would warrant a more thorough investigation of all the details, so we can make an analysis such as would justify a conclusion.

DR. HESS: If you will allow me to explain, I think, Mr. Rosewater has misunderstood my paper. The total contract for our city was for the collection, removal and disposal of garbage and night-soil. For instance, Mr. Rosewater would make a proposition to our city to construct his own plant and collect the refuse and garbage and night-soil, convey it to his plant and dispose of it, for a consideration of $120,000, without any further care on the part of the city, the contractor furnishing his own plant, his own material, his own land, his own horses, and his own men; on the other hand, the crematory people make the same proposition, to collect and dispose of garbage for $140,000. So that, in itself, shows that the reduction method is the most economical. Now, then, I have got the data of the cost of the various plants, with the number of men employed and the amount of fuel that is required to dispose of the garbage, for instance, in the report which I intended to submit to the convention.

Mr. Rosewater: I fully understand the position of Cleveland on that subject. I know that the bids involve the collecting of this refuse and the disposition of it—everybody understands, when you advertise for bids, for the construction of a sewer or for any other construction, you will get bids very widely apart, and these bids depend entirely on the ability of the contractor to handle men, to know how to get teams and handle machinery, and it doesn't always follow that those methods are best; one man may be satisfied with ten per cent., another with twenty. I still think that for the city of Cleveland the acceptance of the lowest proposition is the proper thing, yet it does not give us a sufficient basis to come to any conclusions as to the most economical methods of procedure.

Mr. Keating, Toronto: In regard to the collection of garbage at the places you describe, do the residents of the houses put the garbage in boxes or receptacles, or is the separation done by the collector or the parties handling it after it is collected? This is a matter attracting a great deal of attention both on this side of the water and on the other. I suppose, the attention of this committee has been called to the fact that they are utilizing garbage in England for the purpose of producing steam, for lighting by electricity, and it was described by Lord Kelvin, on his recent visit to Toronto, in connection with the British Association. He stated that ten tons of garbage was equal to about a ton of coal. I had a conversation with some of the members of the association on the subject, and they spoke in the highest possible terms of it; they stated that Lord Kelvin had underestimated the value of garbage, its actual worth being about eight tons of garbage to one ton of coal.

Dr. Hess: Mr. President, in answer to the question as to the manner of handling the garbage by the residents in the cities where they have got the reduction method of disposal, they have separation ordinances which require people to have receptacles for garbage, separate from the ashes; they still have difficulty in places, from the fact that there are a great many tin cans and bottles and dish rags, shoes and boots and the like, thrown in the garbage. There have been no complaints about ashes at all, but I might say, that the great city of Chicago has Mr. Anderson there, who has patented a system several years ago along the same general lines of the Shortage system mentioned, to dispose of garbage, ashes and manure and the like, to furnish heat and power. I do not know whether Dr. Reynolds has learned of the operation of this system in his city. Dr. Anderson called on me two years ago in Cleveland, and requested me to go to Chicago and inspect his model plant; I was prevented from doing so by other engagements. However, Lord Kelvin's idea is not a new one.

MR. A. D. THOMPSON, Peoria, Ill.: Regarding the conclusion of the Chairman, that the reduction system is the best, I would say, this may be true for Cleveland and the larger cities, but the smaller cities have not sufficient garbage to place the reduction system on a paying basis, for the amount of garbage must be large in order that the marketable product may yield a reasonable return for the capital invested.

Three years ago I visited a number of cities of the United States for the city of Peoria, to determine, if possible, the best method for the disposal of garbage in cities having a population of about 60,000, and after investigating all the methods of cremation and all the reduction systems, practically, in the United States, my conclusion was that the crematory system was the best for cities the size of Peoria.

DR. REYNOLDS: Mr. Chairman, I have heard of the Anderson process, and have seen it in Chicago; I do not know whether it is the same or not; it is simply a crematory system we have followed, in Lord Kelvin's tracks, it is true, for years. One of the first things to be overcome, it matters not whether by the system of reduction, cremation or what not, is the odors that arise—the nuisances that arise from accumulations of any considerable amount of garbage at any one point. That will happen to a crematory as well as to a reduction plant; and the system that gets it out of sight the quickest, and keeps it out of sight until it is harmless and odorless, must be the best from a sanitary point of view.

Then, of course, the question of dollars and cents is a most important one. The reduction process, so far as systems have developed, is the only one that leaves any product of any value; but what Lord Kelvin's system may do, we do not know; what other systems—we have recently heard of at Buffalo, where 14,000 cubic feet of gas is made out of a ton of garbage by the addition of chemicals and the application of heat, at a cost of ten cents a thousand feet. Whether that is Utopian or not, I do not know, and I don't think anybody knows. The question is a growing one, and great progress in it has been made in the last few years, and I am surprised and delighted in some recent investigations I have made in the reduction system.

MR. TILLSON, Brooklyn, N. Y.: The city of Brooklyn some time last winter let a contract for the disposal of garbage for a period of five (5) years, at a price that averages about $120,000 per year. The garbage is collected in the city twice and three times a week from the hotels and dwellings; and at the present time runs about 220 tons per day. This garbage is carried to scows, and from there taken down to Barren Island, an island in Jamaica Bay, about nine miles from the center of the city. It is there reduced by what is known as the Arnold process. At the present time, it is the same one that is reducing the New York garbage, but another is being constructed especially for the Brooklyn garbage. The residue, or solid portion, is compressed and sold for fertilizing purposes; but just what the value is I have forgotten at the present time. The effluent which flows into the bay, has been complained of a great deal by the people in that vicinity interested in the oyster industry, and the odor arising from the factory has been complained of very bitterly by people from Far Rockaway, and other neighborhoods. Complaints have been made to the Board of Health of the State of New York, and investigations have been going on for the last two or three weeks. There seems to be a great diversity of opinion as to the fact of whether or not this odor is a nuisance; strange as it may seem, an eminent authority of New York has stated officially, that people who were bothered or put out by the odor must have supersensitive lungs. I have very often noticed this odor in a way that would be very offensive to any one who would be obliged to stay at the place for any length of time—eight or nine miles from the city of Brooklyn when the wind is blowing from the southeast. What action the Board of Health will take in the matter, or what will be the final result of their investigation as to the disposition, of course, no one can tell.

MR. BENZENBERG: I do not know as I can throw any additional light upon this subject. It is certainly one of the most vexed questions that confront the municipal authorities at the present time. And it is made more so because of a sentiment existing in the public mind that it seems impossible to remove. The word "garbage" contains to the citizen all the offensive odors and nuisances that the mind can imagine. Whether the facts support his imagination or not matters little to him, the word "garbage" is like a red rag to a bull; it arouses him and he is a kicker at once.

I visited a plant in Philadelphia which was largely an experimental one. They were disposing of fifty tons of garbage per day, without receiving any pay therefor. The garbage was delivered on the premises and the parties were paying for the cost of operation by the products they derived from the garbage—they received no other compensation. The report of an indignation meeting held the night before gave us the first information regarding the existence of this plant, and anxious to see what there was to it, we visited the plant. As we came into the neighborhood of the plant it seemed that everybody came out on the streets, and, taking us for local city officials, began to remonstrate with us about the doings of that horrible plant, which simply had destroyed the value of the property, and was compelling the people to move away from that district. Finally we made the people understand that we were strangers and investigating the matter, when they overloaded us with their advice that we should certainly not allow any such a plant as was there in operation to be constructed in our city. We went through the plant; it was the cleanest plant we had seen on the entire trip; there wasn't a particle of odor on the inside of that building. There might have been some odors arising from the smoke stack, but we investigated that, and found the only smoke that was arising came from a gas generator, which was producing gas, which was delivered as fuel to the boilers, but there was nothing in the way of a nuisance about that plant.

I am satisfied that the development which has taken place in the reduction of garbage in the past five years will continue for another five years at least, and that there are plants to-day operating on a much better scale and with better results than the Merz system was five years ago—which was at that time considered the best in use, and these will be as far behind three or four years hence as the Merz system is to-day—that is, the old Merz system. I believe that in the course of time the systems will be so improved that the money obtained for the products from the reduction plant will be sufficient to pay for its operation, and leave a profit besides. This party who was using fifty tons of garbage per day certainly was doing that, and doing it to his own satisfaction. He arranges his methods of reduction somewhat different from that generally used, of either the Arnold, the Holthaus, or the American reduction system.

The question arises, naturally, how much it will cost the city to contract for the disposition of garbage; and where are you going to place the plant? If you place it inside of the city, in the neighborhood of habitations, you certainly must compel your contractor to collect all the odors and carry them by conduits to boilers and to condensation tanks. It is utterly impossible to absolutely dispose of the gases and the offensive odors in any other way than both by fire and water. That will add materially to the cost of disposal which naturally must be paid for. If, however, you can locate your garbage plant at a point where it is not necessary to use this expensive method of disposing of the offensive odors, then that much money is saved in the operation of that plant, and the contractor can afford to do the work for so much less money. The question of incinerating garbage certainly comes in competition with that of reduction. There are many who have made the question of garbage disposal a study. Engineers have been induced to think more favorably of the continental systems of disposal of garbage, which is by incineration, than of the American methods. That, however, depends a great deal upon the nature of the material to be collected. The incineration process succeeded well in England; it was introduced in Germany and it signally failed. They laid the difficulty to the engineers and firemen, that they didn't properly understand the disposing and treating of the garbage by burning it; they sent to England for firemen to handle it, who, when they arrived at the plant, immediately saw that it was impracticable to carry out the same plan and system adopted in England. Why? Because the German citizen was too thrifty and sifted his ashes, and allowed no combustible to remain, so that when the ashes and garbage were gathered together, it contained no combustibles which would aid in burning the same. In England there is a large amount of combustible still in the ashes, and when mixed with the garbage, assists in destroying and burning the garbage without any addition of coal. The result was that in Germany they had to add a certain percentage of coal to the garbage in order to successfully burn it; that added to the cost and it was no longer as economical a plant as it was in England. Many of the incinerating plants in this country are doing the work of incinerating thoroughly. There is no doubt that, unless a great deal of care is exercised, a good many of the gases which enter the smoke stack, though a great deal of pains is taken in destroying these gases by maintaining a fire at the base of the stack, will escape from that stack. There may be a great difference of opinion whether that odor is offensive—offensive enough to cause a nuisance—but with this sentiment in the mind of the citizens against any garbage plant, you cannot reason with them that the odor is not offensive; they will simply insist upon their view of it, that it is a gaseous and offensive odor from garbage destruction, and that it is intrusive, that it is destroying the enjoyment of life in the immediate neighborhood, and he is compelled to dispose of his property and get away from there at a loss. The question arises whether to combat or to attempt to combat that sentiment—or whether it is not best to pay for a thorough reduction system by disposing of all gases as they can be, by condensation and fire, and also to purify the effluent from the tanks so that the water is clear and pure and no nuisance can be created by draining it off into any channel. It is a matter that cannot, under the present conditions, be helped, and it may be best to pay a little more for the work and have peace in the family, than to attempt to do it by a cheaper method and continuously have the citizen upon your back. I am satisfied that all the gases can be absorbed, or can be destroyed, and that the water can be made clear and pure. The water from one of the effluents of a reduction plant was so pure that I did not hesitate to drink of it. It costs money to reduce refuse to that condition; however, I think, under present conditions we cannot do any different but pay it, and have it done properly.

Dr. Reynolds: I simply want to ask Mr. Benzenberg this question. I understood you to say that you thought very soon that the reduction of garbage would pay for the handling of it—did you mean the collection as well as the disposal?

Mr. Benzenberg: No sir, in making that statement, Doctor, I had reference only to the disposition of the garbage, and not to the collection of it. The collection, it seems to me, should be conducted entirely by the city, under the city control, because unless the department which has charge of the garbage question has absolute control of the collection, it will be flooded with complaints. You cannot compel a contractor to collect as thoroughly as if you have charge of the men themselves, and have them understand that if a single complaint arises in their several districts, they will be discharged, or there will be an amount deducted from their pay. An application of a fine of that kind soon compels the men intrusted with the collection of garbage to perform their duty thoroughly. The contractor's employé cares little for the receptable or utensil of the private citizen, however expensive or cheap it may be. Of course, that can be somewhat controlled, but not so directly or easily as if the men who are engaged in the collection of the garbage are directly in the employ of the department which has charge of the same, and I believe that generally it can be done just as cheaply.

In some cities, perhaps, where, by ordinance, eight hours constitute a day's labor for city employés, the collection of garbage may cost somewhat more than if the same were done by contract, but it is worth something to have it done properly.

The reduction of the garbage, however, I believe, can be better done by contract, because a contractor can better dispose of his products than could a city. He can, as he finds it necessary, improve his products by purifying the grease and by manufacturing different grades of fertilizers, all of which will greatly enhance the value of his products.

At one of the reduction plants I noticed that the grease obtained from the garbage and dead animals had been gradually improved and bleached to such a state of purity that neither by sight nor smell could it be distinguished from salad oil. It was clear, pure and sweet. It was merely a matter of treatment and undoubtedly paid well for the extra labor. So with the fertilizing base which can be converted into different kinds of perfect fertilizers to meet the demands of the market. If the plant were owned by a municipality it would be difficult to produce such results because of the differences of opinion in the public mind as to what should or should not be done.

MR. LEWIS: It might be imagined, from some of the criticisms that are made of the modern method of dealing with garbage, that the new methods were inferior to the old, and that we were in the dark and moving in the wrong direction. To refer for the moment to the experience of New York and vicinity, the old methods and the new cannot for a moment be compared. We were a pretty conservative lot around New York City, and New York Harbor. We used to use our garbage in rather a novel way. We used to bathe in it along the coast of Long Island and New Jersey. There were, I venture to say, on warm summer days, people bathing in the waters of the Atlantic as many in number as the population of the City of Nashville—people who could not go to Newport, could not go to Bar Harbor, and who were compelled to go to the nearest point. We used to bathe, and come out with tomatoes in our hair, and corn husks, melon rinds, and a choice collection of similar matter distributed over other parts of the body. This year and last year the water has been clean, absolutely clean. There is perhaps a little odor when the wind is in the right direction from Barren Island, but it is certainly infinitely preferable to the old New York system. To be sure, "it floats," but it can by no means be identified with that Cincinnati product which is also extensively advertised to float.

THE PRESIDENT: The next thing on the programme is the report of the Committee on City Government and Legislation.

MR. VAN DUYNE: May I speak a minute? The responsibility has been imposed upon me of naming the committees for the next year. I will be very glad if any of the cities represented here having some member who has given special attention to the study of some one of the subjects, would mention the name of that party, to help me in forming the committees. I do not mean to say that all the men suggested would get on a committee, because the number of places is limited, but still it would help, and perhaps work to the advantage of our next meeting, so that if any time to-day I can receive any suggestions, I will be very thankful for them.

THE PRESIDENT: Mr. Brown has written a letter regretting that he cannot be with us on account of press of business; he has sent his report—a paper—and asks that the Secretary read it to the convention; it is not very long—just seven pages. I understand, Mr. Benzenberg, that Dr. Kempster has not his paper ready.

MR. BENZENBERG: The doctor told me that when he returned to town he would mail the paper to me, but have not heard from him.

Here Mr. Farnham, at the request of the President, read to the Society the following paper:

THE METHODS OF APPOINTMENT OF BOARDS OF PUBLIC WORKS AND ENGINEERS, AND CHECKS UPON THEIR ACTION.

CHARLES CARROLL BROWN, CONSULTING ENGINEER, BLOOMINGTON, ILL.

Only a part of this subject will be considered in this paper on account of time and space limitations for its complete presentation. Nearly all our cities lie between the limits of population of 5,000 and 200,000. These cities can all work under the same general plan, with some modifications in details. Such a plan is here proposed for the cities of average population in the list, with some hints of desirable modifications for the larger cities. Other modifications will be necessary in each special case, on account of constitutional limitations, fixed methods of procedure which could not be changed without working injustice, and to some extent on account of local customs in general.

The fundamental principles upon which the selection of members of the Board of Public Works as a whole should be based, are technical knowelge and business capacity, honesty being assumed as the one absolutely essential characteristic, though often neglected, and sometimes purposely.

While strictly expert knowledge is not demanded of all members, at least one should have this knowledge. Public work is of several kinds, practically independent in a technical sense, and more than one kind of expert knowledge is frequently demanded.

Excellent technical training may be possible without business capacity and may lead to failure from lack of consideration of practical methods of laying out work and carrying it forward. Good business sense under technical direction can often be obtained on a Board and where both can not be obtained in the same person will, frequently, give as good results.

In a small city, where municipal ownership of natural monopolies is not in vogue, one man can take charge of all the actual work in progress at any one time. In such cases one man of technical ability of sufficiently high order to make his decisions respectable and with reasonably good business ability, should be on the Board and take charge of the work. He would perform the duties now devolving on the City Engineer and the Chairman of the Council Committee or the Board of Public Improvements. With him should be associated, perhaps, two other members of high standing in the community for business capacity and integrity and for intellectual attainments, who, with the chairman-engineer should be responsible for the general principles upon which the work would be conducted, and the policy of the city regarding public improvements. The chairman should receive a sufficient salary to make possible the securing of a first-rate man for the position. The duties of the other members of the Board being less onerous, their compensation can be largely in the honor of the appointment; in fact, there are many arguments in favor of making the office entirely without compensation in the cities where the amount of business is too small to require the entire attention of the second and third members of the Board. The Board as a whole should be removed as far as possible from politics of any sort. The engineer member would frequently be selected from outside the city, and his appointment should depend solely upon his technical and business qualifications. His fitness may be determined by examination, if any reasonable method is available in the probable lack of sufficient technical ability in the city itself to conduct the examination, and by the consideration of credentials showing his technical attainments, his experience, technical and business success and character. The term of office should be fixed at a reasonably long period and removal possible only for cause well established. The present tendency to employ home talent without reference to ability, simply because it is home talent, when much more competent men can be easily secured outside, is essentially vicious and, even in the large cities, leads to the employment of incompetents. The other members of the Board act as advisers upon questions of policy, as checks upon the business methods of the engineer, to give weight by force of numbers, and to divide the responsibility of important decisions. Intelligence, knowledge of business methods, reasonable familiarity with technical details, and ability to make prompt and reasonably accurate decisions upon questions with given data, are essentials to the most valuable service.

Most of the work of public improvement in the small cities proceeds or does not proceed, perhaps, rightly enough, according to the general sentiment of the citizens. Provided, the work, when done, is properly done, the change in rate at which it is done may make little difference. The terms of office of the members other than the chairman may, therefore, depend more or less closely upon the term of the Mayor. It is desirable, however, that at least one member on the Board, other than the chairman, be familiar with the work that has been done and the plans for future work, so that but one member should be changed at a time. If the council has a check upon the work of the Board, as suggested later, a change of policy with a change of administration is readily made, but probably with more friction than in case the change of policy is reflected in the membership of the Board itself. If the membership in the two advisory positions on the Board is likely to be changed entirely with every change in the administration, a provision that no work can be decided upon without the affirmative vote of the Chairman, would prevent the possibility of technical mistakes by new members selected for a special purpose and prepared to carry out that purpose without regard to technical matters upon which they are ignorant and which they wrongly consider to be unimportant. A well-constituted Board will, however, follow the demands of public opinion so far as it can be done with a proper regard to economy and to stability of construction, justice and the necessities of the city. Unquestionably the appointments to the Board should be made by the Mayor and confirmation by the council should not be required. The checks by the council upon the action of the Board are suggested below.

All questions regarding public improvements and the carrying out of the same should be in the hands of the Board of Public Works for formulation of plan and supervision of construction. The completed plan should be referred to the City Council in the form of ordinances authorizing the improvement and providing the funds to pay for it. The Council should have the power to decide for or against the improvement, but should not have any power to change the plan as a whole or in any detail without the direct and formal action of the Board of Public Works. This method of procedure will place the responsibility for the plans and for the supervision of the technical details in the hands of technical experts and men of business training and special experience, but will leave the decision as to actual construction and levying of taxes to the Council, the direct representative of the people. The Council will be relieved of duties which are very onerous, and generally distasteful, most Councilmen admitting that they know nothing of the technical matters and that they would be very glad to get rid of them if there were any possible way. It would at the same time retain the power of ultimate decision upon the question, which of right belongs to it. A further check upon both bodies can be secured in the case of improvements which are not absolutely essential, if a remonstrance from a definite proportion of the property owners can stop an improvement. The provision in Indianapolis, that a majority of the property owners *resident* on the line of the proposed street or sidewalk improvement, can prevent its construction by proper remonstrance, works well and is there the only check upon the Board of Public Works which the property owners have, the Council having no powers in matters of public improvement not requiring public funds until after such sufficient remonstrance is filed. It is very evident that a provision requiring the Board to wait until a petition of a given length is filed before proceeding with an improvement is very detrimental to the interests of the city. It destroys the power of the Board to follow a logical plan of improvements, unneccessarily delays the completion of the system, adds to the expense of construction and maintenance, and makes it possible, frequently, for one or two obstructors to keep back the improvement of the city indefinitely. Then, too, there are many property owners, who will willingly pay for an improvement, who would not sign a petition for it. Those of us who are familiar with the inception and methods of circulation of petitions for most street improvements, can give many reasons for this.

When the city owns its water works, electric light plant, or other natural monopoly, the supervision of the same and the plans for improvements and supervision of construction should be in the hands of the Board of Public Works, subject, so far as appropriation of money is concerned, to the action of the Council. In such cases it may be desirable to increase the number of technical men on the Board. This is not necessary in most small cities, such as those now under discussion, the superintendent of the works, employed by the Board, and the engineer member of the Board being able usually to take care of the technical control of the plant with occasional aid from consulting engineers who are experts in these fields. One reason why it is not always desirable to add the superintendents of such plants to the Board is that the order of talent required to run the ordinary small light or water plant is somewhat different from that required to design the works or to consider it in its larger relations to the activities of the city. If it is considered desirable to add such technical members to the Board, they may be added to the number of the Board, or may displace citizen members. The first method is, no doubt, preferable in the smaller cities. The latter may be the better in the larger cities. The law should be flexible enough to permit of whichever method of procedure is the best at any particular time. The modifications of the general plan just hinted at, and an additional opportunity to modify salaries as the members of the Board are required to spend more of their time in the work on account of the growth of the city, will make it possible to fit the scheme to any city within the limits of population which were set at the beginning of the paper.

The Board should be free to select its own employees as the members would in their own business, without reference to political preferences. If a civil service system is necessary to secure complete divorce from politics, it should be established. Until men are as willing to run the general business of the city on business principles as they are their own, a civil service system may be necessary to prevent all forms of favoritism.

The usual program for the Board would be the determination of definite systems for the various kinds of improvements, conferences with the Mayor, Council and leading citizens as to the best methods of setting the plan in operation, and, when some method of procedure has been detrmined upon, the presentation of individual portions under a regular form of process prescribed by the law. The following program is proposed for the progress of a resolution calling for an improvement, giving an idea of the powers of the Board of Public Works and the Council and the interested taxpayers, and the checks of each upon the other.

The plans and specifications for the proposed improvement having been prepared according to the general scheme for the particular class of improvements, the Board of Public Works would pass a resolution of intention to proceed with the construction of the particular portion under consideration, and would set a day for hearing remonstrances and suggestions for modifications. After the hearing, the resolution as originally prepared or as amended would be adopted and ordinances prepared for presentation to the City Council. These ordinances would authorize the construction of the work, an assessment upon the property benefited, and an appropriation of city funds to pay the portion assessed upon the city at large, if any. In the case of street and sidewalk improvements, street cleaning and sprinkling contracts, an opportunity for remonstrance should be given to the persons interested. As already stated, the provision that a remonstrance signed by a majority of the resident property owners shall stop further proceedings unless there shall be a two-thirds vote of the Council in favor of the improvement, works in a very satisfactory manner. In case of sewers, drains, water supply or other improvements, where a large part of the cost is to be paid by the city, or the benefit to the city at large is nearly or quite as great as to the property, even if the property pays the whole expense, such power of remonstrance should not be available, principally because the taxpayers generally are not well enough informed regarding improvements involving underground constructions to be able to vote intelligently concerning them, and are very likely to vote the way that will make the least present draft on their pocket books, without thought of the greater draft that must come later if the matter is postponed. A short time should be given for the filing of this remonstrance, not more than ten to twenty days. The resolution having passed this stage, the ordinances may be acted upon by the council. If adopted by them, the Board will advertise for bids, let the contract, supervise the construction and make the assessments. If the assessments are authorized at the time the work is authorized, it should not be necessary to refer the matter to the Council again, but some authorities prefer an assessing ordinance at this stage in the proceedings.

When the ordinances are first presented to the Council, they have the power to accept or reject them, but they should have no power to modify them in the slightest degree, so far as their technical features are concerned. This provision is in strict keeping with the theory upon which this proposed method of procedure is based, namely, that the technical portions of the work have been delegated to the Board of Public Works, because the Council is not sufficiently expert in such matters, and a properly constituted Board of Public Works is. The Council has the general power, by rejection of ordinances proposed by the Board, to check the Board if it should fall into extravagant or dishonest ways or should proceed on lines which the general sentiment of the city does not indorse. In such cases the Board must modify its course, being given the opportunity to do this on lines which shall be correct from the engineer's points of view, or, if it is certain, upon further consideration, that its original position is correct, it can enter upon a "campaign of education," to bring public sentiment, as expressed in the Council to its view of the case. For such improvements as are subject to remonstrance, it is probable that the Council would seldom differ from the decision of the Board unless there was an overwhelming remonstrance from the property owners. In the case of most other constructions the check of the Council upon the Board is very salutary, though in some instances it causes serious delay in the construction of improvements vitally important to the life and health of the community. Usually, however, the delay is not serious, and causes discussion which may lead to improvement in the plans.

If the city does not have a limit of indebtedness which cannot be exceeded, it would be well, in cities of the size under discussion, to have a provision that all improvements which draw upon the city's funds for more than a certain percentage of the assessed valuation, must be authorized by a majority vote at a special election. This would place some check upon extravagance in both Board and Council. The citizens at large may generally be trusted to tell what they want in such cases, and a decision that an improvement of such magnitude is not wanted should be heeded, even if it actually cripples the usefulness of the Board for a long period and works against the real interests of the people at large. A campaign of education and its full discussions will again result in valuable improvements in the original plans.

This paper is already long enough and the mention of other important points will be deferred.

THE PRESIDENT: The next report is that of the Committee on Review.

Capt. Lansing W. Beach, Chairman, Washington, D. C., here read to the Society the report of his committee, which was as follows:

REPORT OF THE COMMITTEE ON REVIEW.

MR. PRESIDENT AND GENTLEMEN:

The President of the Society, in his opening address at the last annual convention, suggested the appointment of a Committee on Review, the duties of the committee, as he explained them, to be as follows: "Said committee to carefully review all annual reports and submit to this Society, at its annual meeting, a synopsis from such reports as contain any data or information of value upon, or an account of any work in which this Society or any of its members are interested, giving special attention as to results obtained (be they either favorable or otherwise) and the comparative cost of such work. When a report refers to any new feature or a novel method or design in municipal work, particular mention should be made, and, if of enough importance, the official making such report, should be requested to prepare a paper upon the subject, to be read before this Society at its next convention. Thus the members can be kept in touch with every new feature or development in public work and with its effect or benefit as to its enhancement and durability."

From this it was considered that the committee were not called upon or expected to prepare lengthy papers upon any one subject, but rather to devote themselves to ascertaining special features of construction or method adopted, or particular results obtained, and report such to this convention. The only cases where papers might be called for would be in matters not covered by any of the other committees, but on subjects for which there were other standing committees. If the Committee on Review found any incident or work which would be of particular advantage, they would request the parties most interested or best acquainted with such work, to prepare a special paper for presentation to the convention.

The committee, upon the outset of its work, met with a difficulty which it is believed was not anticipated by the President in his opening address, and certainly was not expected by the committee, that is, the meagreness of municipal reports in general.

The reports consulted, with a few exceptions, were of such a nature that only a person intimately acquainted with the cities in question, could thoroughly understand them, and as many contained little more than a mere statement of work done, it was impossible to extract much information. One reason for the meagreness of the reports in general is believed to be the enforceed economy in printing, the municipal authorities being frequently compelled to keep their reports down to the smallest intelligible limits. Another feature is that engineers or other authorities rendering reports, generally reserve the description of anything special for a monograph before some engineering or technical society or for an article in some professional or technical journal. A great many reports of cities were examined and although some were found to cover the work in their respective localities very well, but little that was special or would be of interest to members of the Society was found, and in most of these cases, the matter contained in the report was repeated in some professional journal or paper.

It is recommended that, if possible, a map of each city be included in the annual report, or, if this involves a greater expense than is considered advisable, that a note be inserted, informing parties where such maps can be purchased, and the price. Many lithographing firms would be glad to print maps of a city, trusting to receive their compensation from future sales; and an outline map upon a scale of from 800 to 1,200 feet to an inch, can be very easily prepared and lithographed at very small expense.

Under these circumstances, it was considered that perhaps the better plan would be to address a circular to municipal officers in the principal cities of the country to inquire what special work had been done in their places, and the circulars in question were sent to every important city and town in the United States. Hardly one-tenth of the parties addressed took the trouble to reply. Extracts from some of the letters received are appended hereto. When a circular letter or a letter requiring information is sent to any member of this Society, he almost invariably answers it, and answers it promptly, and this has not occurred in other cities.

The committee refers to a couple of reports which they consider very good in their class.

The city of Newton, Mass., gives a very complete and detailed report for the year ending December 31, 1896, of the various operations in that city. The report is quite liberally illustrated and forms a model in many respects.

The city of St. Louis has issued a pamphlet entitled "General Information City Streets, St. Louis, 1897," which is profusely illustrated and forms a valuable book for reference.

J. H. Dingle, City Surveyor, Charleston, S. C., states: "Nothing of importance has been undertaken this year by the city except the improvement of Chicora Park, which the city bought a year or so ago for public purposes. This was, before its purchase, a tract of cleared land and woods of about 600 acres along Ashley River, and about six miles from the Court House. Part of this cleared land has been leased to the Charleston City Railway Company for the purpose of inducing them to continue their line to the park and thus enable the masses to easily reach a place of recreation. The company is at present building a waiting station, pavilion and bowling alleys on their portion of the park and the remainder consists mostly of woods of tall pines and stately moss-covered oaks, and has been turned over to Messrs. F. L. and J. C. Olmstead, Landscape Architects, Brookline, Mass., for improvement."

During the year the old horse cars have given place to a first-class trolley system using 6"x7"x9" grooved girder rails.

A. L. White, City Engineer, Wheeling, W. Va., states: "City Councils last April passed an ordinance fixing the duties and salary of the City Engineer. Prior to May 1st the City Engineer was only so in name; he was under the control of Boards and Councils and exercised but little control or discretion; he was simply a surveyor, to give lines and grades when ordered. He received no salary but fees, and was at liberty to conduct a private practice. You can well imagine the results of such a system. No official map of the city, no street monuments, no sewerage system but many sewers; poor system of water and gas pipes; in short, no records; no intelligent or responsible head or control of engineering work. Briefly, the ordinance places all surveys and engineering work of the city under the direct control of the City Engineer, who gives bond. He is required to give his entire time to the city. When not engaged in construction work he is required to make complete survey of the city, set street monuments, locate sewer, water, gas or other pipes or mains, and make a map of same. The ordinance was passed after an examination of the ordinances and reports of about 100 cities. The Salt Lake City ordinance was followed in the main, but the Wheeling ordinance is more complete in many respects. It has resulted so far in better and cheaper work. Its results will be far-reaching; comes as near putting the Engineering Department on a proper basis as our city charter would permit."

T. K. Dunn, City Engineer, Petersburg, Va., states: "No work special in its extent or character has been undertaken in Petersburg, Va., during the past year with the exception that an emergency pump of 150,000,000 gallons' capacity has been added to the regular pumping stations."

Joseph P. Phillips, City Engineer, Scranton, Pa., states: "There is at present being constructed about 6,000 lin. ft. of telephone conduits by the Central Pennsylvania Telephone and Supply Co., for their own use. They are the first conduits constructed in this city. I think it was a mistake that the city did not construct conduits and compel all wires to be put underground."

Mr. N. P. Lewis, Engineer of Street Construction and Maintenance, Brooklyn, N. Y., reports: "I can only say that in Brooklyn the improvements to the streets have been actively pushed, in fact, there is every evidence that improved pavements are exciting far greater public interest here than any other municipal enterprise. Of course, Brooklyn has been a fruitful field for missionary work, as it has been a wretchedly paved city and we will still have at the close of this year about 244 miles of cobblestone pavements. We will lay, however, during the year about seventeen miles of asphalt. No changes have taken place in methods of construction except that the practice of setting our curbstones in concrete is now the rule. Our asphalt, laid by different contractors, seems to be satisfactory, although the work has been done at exceptionally low prices. The average cost of the asphalt pavement with one inch of binder and two inches of wearing surface and six inches of concrete foundation, with five years' guarantee, for the year will be about $1.68, although contracts have been made for $1.47 per square yard. This is all repaving and includes the removal of old material and the necessary grading and regulation of the surface. Somewhat over two miles of brick pavement will have been laid before the end of the year, and while it is much liked by many drivers, it costs about 30 per cent. more than asphalt, and petitions for new pavement are almost unanimous in asking for the latter material The work which has been done and is planned, consists for the greater part in extending already established routes of smooth pavement or connecting sections now separated by wastes of cobblestone."

Mr. Earnest Adam, Engineer of Street and Sewer Department, Newark, N. J., states: "It may be of interest to state an experiment which I ordered to be made during the construction of a brick sewer. The total length of sewer as planned, 11,300 feet, practically runs along the border of the upland, and the whole of it will be under high water level, the invert at zero point is 2.00, and at the end 3.65; the dimensions of the sewer are 4′ 10″x3′ 8″ and 3′ 6″x2′x4″, at the respective points, with a fall of only ¾ inch to 1¼ inch in 100 feet. Only 6,000 feet of the larger section are now under contract and construction. The material found in the trench is generally quicksand with some sections of typical bull's-liver. Where the bull's-liver was encountered concrete 12 inches thick was placed between the box and sheathing; the latter was driven to a depth of 3 feet below floor plank. The light grade, only ¾ inch per 100 feet, made it necessary to secure a firm foundation, before any masonry work was commenced; I ordered 35 tons of bar lead placed upon 49 sq. ft. of flooring, making 5 tons to the lineal foot of trench, which is about equal to the superimposed weight.

The result of the experiment was as follows:

11 a. m. to 2 p. m., 8 tons load settlement of floor, .11 of a foot.
At 4 p. m., 16 tons load settlement of floor, .02 of a foot.
Following day, 10 a. m., 35 tons load settlement of floor, .01 of a foot.

That is, the weight of 35 tons was left on the floor for 16 hours before the last settlement was measured. The first settlement of .11 was due to the uneven bearing of the floor planks until some weight was placed upon them. The bottom at the spot where the experiment was made was so soft and shaky that when jumped upon, the soil would be affected for 10 feet in either direction. There are about 2,300 feet of sewer completed at this date and the trench refilled. I have had no levels taken to ascertain whether the sewer had settled but will do so within the next few weeks.

Mr. Beach: I will state that Mr. Adam informed me yesterday that those levels had been taken, and the result was entirely satisfactory. No further settlements have taken place.

W. L. Glazier, City Engineer, Newport, Ky., states: "The changes that we have introduced from former systems have been, first, change from the contract system to men employed and city ownership of street and sewer cleaning plants. We have purchased the necessary stock—sweepers, sprinklers, wagons, etc.—and employed men and even this first year with this extra expense have saved over 20 per cent. on the contract system and expect next year to reduce the cost 20 per cent. more. We have introduced the combined concrete curb and gutters on our macadamized residence streets. We used 6" curb and 16" gutter made from crushed granite boulders and German Portland cement. We have been paying from 61 to 65 cents per lineal foot for the combined curb and gutter as against about 75 cents for 4" and 16" gutter of Indiana Flat Rock limestone. It is giving excellent satisfaction. Nearly all of our streets are 66 feet wide and the width previously established has 42 feet for roadway and 12 feet for sidewalks. We have changed now to a 36 foot roadway and 15 foot sidewalks, except where we have double tracks on street railways. Owing to hard times but little improvements have been made. One street, Columbia, is being reconstructed with brick paved on the usual concrete base. No sewer extensions have been made this year. We are troubled with the nuisance of private street sprinkling, but hope to have it all done by the city next year. One thing I wish especially to mention; the evil of having the streets torn up for the purpose of connecting with sewers, etc. We probably endured the evil in as gross a form as was possible; the streets were literally ruined. Last December we had a law passed similar to the one operative in Washington, D. C., and in Brooklyn, N. Y., compelling persons opening same to deposit a sum of money to pay for the proper repair of the street. Since then we have had no trouble. Thus the city of Newport has received a substantial benefit from the Society."

Mr. McComb, Superintendent of Sewers, Washington, D. C., reports: "I respectfully submit the following notes upon the 'Decarie Automatic Gulley Cleaner': This apparatus, which is in use in the city of Montreal, was designed for cleaning street catch-basins. It consists of an air-tight iron tank mounted upon a wagon which carries in addition two air pumps for exhausting air from the tank. These pumps are operated by eccentrics which are attached to the rear axle of the wagon. A suction hose, attached to the tank, is inserted into the catch-basin, the contents of the basin are stirred by manual labor, a valve is opened and the contents of the basin are transferred to the tank. The wagon then proceeds to the next basin and, if that basin is not too near, a partial vacuum sufficient to empty it will be created, otherwise a trip around the block is necessary to secure that result. The catch-basins used in Montreal are much smaller than those generally in use in cities of the United States and the basins which I saw cleaned did not have as large quantities of heavy street detritus, sand, etc., as the Washington basins retain. With the relatively large amount of heavy material found in the Washington basins, I think, it would be difficult to stir it up so that it might be transferred to the tank. Again, the necessity for hauling the heavy machinery to the dump with the material removed from the basins in addition to the side trips to work up a vucuum, are serious objections. The stirring of the material in the basin creates odors in its vicinity, yet, as a whole, the operation of removing the basin contents by this vacuum process is less objectionable from that standpoint than the old-fashioned way of removal by scoop and bucket.

Respectfully,
D. E. McCOMB,
Superintendent of Sewers."

G. H. Benzenberg, City Engineer, Milwaukee, Wis., states: "I do not know anything in the way of changes in construction methods or improvements of any form made in this city during the past year, excepting the step that has been taken in barring, by ordinance, the laying of any further pavements upon our streets with perishable material, that is, wood, and without providing a concrete foundation, a copy of which I herewith enclose.

I think, this is a radical step in advance and in the right direction. Aside from this, I do not know of anything in the way of any changes that would be of interest.

AN ORDINANCE.

'To determine the kind of material to be used in the construction of pavements on the roadways and streets in the city of Milwaukee, and to provide for the method of laying the same.

The Mayor and Common Council of the city of Milwaukee do ordain as follows:

SECTION I.

Whenever the roadway of any street in the city of Milwaukee shall be paved or repaved, the material used shall be either stone blocks, paving brick, or asphalt, laid on a concrete foundation, to be made according to specifications on file in the office of the Board of Public Works. The provisions of this ordinance are not to apply to alleys in the city of Milwaukee.

SECTION II.

All streets which shall be used for heavy teaming or traffic shall be paved with stone blocks, the joints to be well filled with tar.

SECTION III.

Whenever it is declared necessary, all streets where the traffic is not too heavy and all residence streets, shall be paved with asphalt or paving brick.

SECTION IV.

Whenever any existing wooden block pavement is to be repaired, the joints shall be filled with fine gravel and paving cement, so as to make the surface water-tight.

SECTION V.

No concrete foundation or pavement shall be laid on any street until all necessary water, gas, and sewer connections have been made and conduits of any description shall have been laid for at least six months prior to the pavement of the street.

SECTION VI.

All ordinances or parts of ordinances contravening the provisions of this ordinance, are hereby repealed.

SECTION VII.

This ordinance shall take effect and be in force from and after its passage and publication.

Passed December 7th, 1896.'"

A. C. Bell. City Engineer, New Orleans, states: "That this city has recently awarded a contract for the drainage of the Second Section, and part of the First Section, comprising an area of about 5,000 acres, at a cost of about $1,250.000.00, and is the inauguration of the construction of a complete drainage system of the 24,932 acres of the city that are protected from overflow from the river or lake by levees, at a cost of about $6,000,000.00."

LANSING H. BEACH,
E. W. BOYNTON.

Capt. Beach, Washington, D. C.: I do not know that what I wish to say is relevant to the report of Committee on Review, but I found, a few days ago, a copy of a letter which may be of some interest. It is not progress within the last year to which it refers,, but progress within the last eighty years, in the city of Paris, which is famous, of course, the world over as having the most beautiful and best-cared-for streets ever known.

To show how much of this work has been done in two generations, it might be well to read an extract from a letter written by Aaron Burr in 1811, describing the condition of Paris streets; he says this:

"No sidewalks. The carts, cabriolets and carriages of all sorts run up to the very houses. Most of the streets are paved, as Albany and New York were before the Revolution—some arched in the middle, and a little gutter on each side very near the houses. It is fine sport for the cabriolet or hack drivers to run a wheel in one of these gutters, always full of filth, and bespatter fifty pedestrians who are braced against the wall. The gutters are conduits of the water from the eaves of the houses, are carried out a few feet from the roofs, and thus discharge the rain water over your head. In most places there are no such pipes, and then you have the benefit of the water from the eaves."

This was Paris in 1811.

Mr. President, after having conducted the work, in part, of the Committee on Review during the past year, I would like to make this suggestion to the members of the Society—if there is anything especially in their city of interest to the Society, even if it is very small, that they notify the Committee on Review for the next year, whoever they may be, of that particular matter—the method of construction, or whatever it may be in their city. It would help the committee very greatly. The committee starts out, and has to make, as you can easily see, almost a blind hunt to start with, and if the members would voluntarily supply them with information, the work of the committee would be rendered much more valuable than it has been during the past year.

MR. BENZENBERG: I am now well satisfied with the suggestion I made a year ago in my annual address, that such a committee be appointed. I can see that the work of this committee will develop in us a greater interest, possibly, than that of any other committee. I confess that in the report of the committee this time a good many matters have been reported that are new, at least to me, and I suppose to a great many others, and will possibly bring about the introduction of new ideas or new work, or new methods of doing work, in other cities. It gives us all the benefit of the talent that is at work in all the cities,. It is bringing out in this way, what cannot be brought out in any other way, the individuality of men.

THE PRESIDENT: This finishes the programme for our session to-day. It is quite early yet, and as our business to-morrow will take up at least all the morning, and as we have no further session to-day, it may be well to take up one of the subjects on the programme for to-morrow.—Mr. McMath's paper on the Experience of St. Louis, Mo., with respect to Municipal Street Sprinkling, I would like to have Mr. Benzenberg read this paper, also to give us his experience in the matter of street sprinkling. I will say that we in Cincinnati are very much interested in the matter of street sprinkling at present. We made an attempt to get our Legislature to pass a bill embodying exactly the provisions of the St. Louis bill, but failed. We are going to make another attempt to do it this winter.

Mr. Benzenberg here read to the Society the following paper:

THE EXPERIENCE OF ST. LOUIS, MO., WITH RESPECT TO MUNICIPAL STREET SPRINKLING.

BY R. E. M'MATH, PRESIDENT BOARD PUBLIC IMPROVEMENTS.

Prior to August 15, 1887, what street sprinkling was done in the city of St. Louis, was done by private parties at their own expense.

Contractors canvassed for subscription and sprinkled in front of the premises occupied by subscribers, leaving the street in front of vacant lots, at street intersections and in front of non-subscribers' premises unsprinkled. The city charged $10.00 per block as water license and subscribers paid from two cents a front foot upward, monthly.

To test the practicability of general sprinkling, an appropriation was made and 270 miles of streets sprinkled from August 15, 1887, to November 15th. The public benefit was so evident that the voters, in February, 1888, adopted a charter amendment authorizing general sprinkling; the cost to be borne in the first instance by the city treasury, and it to be reimbursed by the proceeds of a special tax levied upon each lot in the proportion which its frontage bears to the total frontage of all lots in the district; the city divided into not less than forty (40) districts. The results have been:

Year.	No. Dist's.	Cost Total.	Perage tax Aver Foot.	Miles Sprinkled.	Season.
1888	43	159,280.41	0.0589	271.94	Apr. 13,—Nov. 30.
1889	43	132,861.90	0.0482	289.03	Mar. 15,—Nov. 30.
1890	43	138,621.20	0.0353	336.93	Mar. 15,—Nov. 30.
1891	43	187,583.34	0.0479	409.65	Mar. 15,—Nov. 30.
1892	45	178,829.00	0.0440	439.99	Mar. 15,—Nov. 30.
1893	45	145,612.00	0.0346	438.72	Mar. 15,—Nov. 30.
1894	54	143,778.60	0.0329	445.50	Mar. 15,—Nov. 30.
1895	54	113,935.75	0.0250	473.34	Mar. 15,—Nov. 30.
1896	54	107,054.25	0.0235	473.34	Mar. 15,—Nov. 30.
1897	54	103,337.50	0.0213	499.51	Mar. 15,—Nov. 30.

The cost per front foot, it will be noticed, has steadily decreased. The figures for 1890 were due to exceptional competition, and an overestimate of the value of a new device.

The public satisfaction with the service has not increased with decrease of price; has rather borne an inverse relation thereto.

It is generally admitted that contractors cannot do the work as described in the specifications (see accompanying copy) at the prices bid. It is also admitted that if done according to the specifications, the service would be satisfactory. In fact, the sprinklers used do not comply with No. 8, and the work is done by two drenchings, instead of four sprinklings.

There is a wide divergence in opinion of how sprinkling should be done, and the time to do it, between property owners and residents who pay for the work, and the wheelmen and pleasure riders, who at certain hours want the streets in an ideal condition of dampness. The sprinkling officials in some degree try to please both sides, and the contractor, as the third party, works both ends in favor of himself.

The rules concerning use of fire plugs have taken present form after several trials. It would certainly be better if there could be special sprinkling plugs, but we have not been able to provide them.

It will be observed that the city furnishes the water free of charge. At the old license rate of $10.00 per block, each city block being counted four times, the water charge would have equaled the present cost of putting it on the streets.

It is universally conceded that the sprinkling contributes to the comfort of our people in other important ways than keeping down the dust.

SPECIFICATIONS.

Amount of Work.—The work to be done consists in sprinkling, in the manner prescribed herein, the roadways from curb line to curb line, of all the streets and public places, and parts thereof, of the "City of St. Louis," as are designated by Section 659 of Revised Ordinances of 1892, as amended by Ordinance No......, within District No......, as defined by Section 658 of Revised Ordinances of 1892, as amended by Ordinance No. 17,788. The total length of streets sprinkled, as contemplated by this contract, is estimated at...........miles.

The number of times and hours of sprinkling, etc., shall be as follows:

1. All streets, avenues, public places, and parts thereof, shall be sprinkled four times a day during the entire season. Provided, that only three sprinklings during the season shall be required on Sundays.

2. When a street is sprinkled three times a day, the first sprinkling shall be completed before 8 o'clock A. M., the second sprinkling shall be

between 10 o'clock A. M. and 1 o'clock P. M., and the third sprinkling shall be between 2 o'clock P. M. and 6 o'clock P. M.

3. When four sprinklings a day are required, the first sprinkling shall be completed before 8 o'clock A. M., the second sprinkling shall be between 8 o'clock A. M. and 11 o'clock A. M., the third sprinkling shall be between 12 o'clock, noon, and 3 o'clock P. M., and the fourth sprinkling shall be between 3 o'clock P. M. and 6 o'clock P. M.

4. All streets, except those which may be withdrawn by the Street Commissioner, shall be sprinkled in regular rotation, and the starting point in the morning shall be the starting point for all the following sprinklings during the day, except on the asphaltum streets, which shall be sprinkled four times daily.

5. The quantity of water required to be delivered on the street at each sprinkling will be determined from time to time by the Street Commissioner.

6. All sprinkling shall be done with two-horse wagons which carry a tank holding not less than 600 gallons, and shall have attached two sprinklers. The wagons must be provided with springs (fore and aft), and must have tires not less than three inches in width. The wagons must also be numbered consecutively, and have the name of the contractor in letters not less than three inches in height, on the rear end of the tank.

7. The sprinklers must be so arranged that the spray of water can be readily stopped by the driver on either side of the wagon. The sprinklers used shall be so constructed as to deliver the proper quantities of water for sprinkling the different street surfaces included in this contract, and the quantity of water discharged shall be regulated by the driver from the seat or foot board. The quantities of water requisite for properly sprinkling the different classes of street surfaces shall be determined from time to time by the Street Commissioner, and the adjustment of the sprinklers necessary to secure the delivery of the proper quantities of water shall be made under his supervision, and, when so made, shall not be changed except by his orders. The sprinklers must be kept in good condition and repair, and the spray of water thrown must be uniform throughout its entire width. Wagons with broken or choked sprinklers, and leaking tanks or valves, shall not be used. All wagons must be inspected before going to work at the beginning of the season.

8. Whenever a sprinkling wagon is unfit for use for any of the above reasons, which fact shall be determined by the Street Commissioner, it shall be ordered off the street, and no sprinkling done by such wagon thereafter shall be allowed in the monthly estimate of work done by the contractor, until made to conform to the specifications, and has passed inspection.

9. Sprinkling must be done with judgment and care, and the street crossings must be kept dry as nearly as possible.

10. If the contractor fails or neglects to give any street or avenue the number of daily sprinklings required by this contract, except in case of rain, or if he should flood the street or avenue, then two-thirtieths of his monthly pay for said street or avenue will be deducted for each day on which such omission or superfluous work occurs.

11. As to whether the contractor has given the streets the number of sprinklings and the quantity of water required, and as to whether rain has obviated the necessity of sprinkling, shall be determined by the Street Commissioner.

12. The hours of sprinkling set forth in this contract may be changed or adjusted from time to time, as the Street Commissioner may determine.

13. The Street Commissioner shall have full power and authority to withdraw any street or part of street from the operation of this contract, either for the whole or any part of the term of this contract, and in such case the pro rata cost of the work thus omitted shall be deducted from the estimates and payments of such contractor; such pro rata cost to be ascertained by calculating the length that the streets so withdrawn bears to the total length of the streets covered by this contract.

RULES AND REGULATIONS FOR USE OF FIRE PLUGS.

The contractor shall have the right to take water free of charge from the fire plugs within his district, except such fire plugs as may be withdrawn by the Street Commissioner, under authority of Section 665 of Revised Ordinance of 1892, as amended by Ordinance No. 17,788, under the following Rules and Regulations: In all cases great care shall be taken to preserve the fire plug in condition to be immediately used by the Fire Department. Any defect of a fire plug shall be immediately reported to the Street Commissioner.

The contractor shall use particular care not to waste any water in filling the tanks, and also in properly closing the fire plug as soon as the tank has been filled. A deduction of two dollars shall be made on the next monthly estimate for every fire plug which is left wholly or partly open, when not in use for filling tank.

The connection to the fire plug for the purpose of filling sprinkling carts shall in all cases be made with a reducing coupling, so constructed as to be quickly removed, and to have an opening not larger than 1½ inches in diameter; except where special permit shall be granted by the Street Commissioner.

The fire plugs shall not be used by the contractor for any other purpose than for filling wagons for sprinkling streets, under this contract. The contractor must keep all street surface and pavement, within a distance of fifteen feet from plug, clean and in good repair.

Great care must be exercised in operating the fire plugs, and any plug damaged or out of order must be immediately reported to the Street Commissioner. All repairs of fire plugs shall be made by the Water Commissioner, who shall report the cost of the same to the Street Commissioner.

When fire plugs are needed by the Fire Department, the contractor shall immediately detach from the plug and remove sprinkling wagon. During the time the plugs are in use by the Fire Department, in the elevated parts of the city, no filling of sprinkling carts will be allowed in that vicinity.

Mr. Adam: Do I understand by this report that the sprinkling actually cost only fifty cents for the whole season, per wagon?

Mr. Benzenberg: I understand that it cost them two and two-tenths cents per foot.

The President: A fraction over two cents per foot per season.

Mr. Adam: That would be only fifty cents per lot. We pay, by private sprinkling, twenty-five cents per week, and then they only sprinkle once or twice a day.

Mr. Keating: Does that report speak of the width of the street?

The President: I may say, in that connection, in Cincinnati we pay, running on an average, about fifty cents a month for a twenty-five foot lot, while under this system it would cost probably sixty cents per annum; in addition to that, we have no sprinkling at all where persons don't own the property in sections of streets not sprinkled. Generally the sprinkling is done in an unsatisfactory manner; they flush the streets, and do it early in the morning and late in the evening. You will notice that under this system it is prescribed how often it shall be done. I talked with Mr. McMath on the subject last week. They are not permitted now to sprinkle both sides of the street at the same time; they lay out a district, and they go out and sprinkle part of a street, and then they come back over the street upon one side, which has become dry, and yet they do the same amount of sprinkling.

MR. THOMPSON: What was the first year reported—1888?

THE PRESIDENT: 1888 it was a fraction over five cents, 231 miles sprinkled, and, coming down to 1897, a fraction over two cents, with 499 miles sprinkled.

MR. RUNDLETT: Mr. President, we have in St. Paul a system very similar to that of St. Louis. The city is divided into districts, and contracts let for each district separately. Specifications are drawn very similar to those of St. Louis, and require that ordinary streets be sprinkled four times a day; asphalt streets oftener, but with a finer spray. The method of doing the work by contract has worked very satisfactorily in a general way, although it is utterly impossible to satisfy every one. I have had complaints from the same street the same day, and within the same hour, one claiming that the street was sprinkled too much and the other that it was sprinkled too little. People's opinions differ so much as to how the work ought to be done. The sprinkling does not commence until April and ends in November, and the cost has been, on the average, about four cents per front foot, assessed against the property. Of this amount we pay the Water Department about one-half for the use of water. The sprinkling being considered a local improvement, it is the theory of our charter that those who are benefited should pay for the use of the water. The price paid the Water Department last year was seven and one-half cents per 100 lineal feet of street per week. We have found it better to use sprinkling hydrants in street sprinkling rather than to allow the use of fire hydrants, and we have a separate and distinct system of hydrants for that purpose.

MR. LEWIS: This question of street sprinkling is a vexed one, and I think the results obtained in most cities are unsatisfactory. I do not believe in sprinkling asphalt streets at all. I have tried strenuously to prevent this, and have always been unsuccessful If you will watch what occurs on asphalt streets you will notice that the horse droppings, after they have become wet, are plastered over the pavement by the sweeper with his broom, and unless he uses a squeegee it is utterly impossible for him to remove them. There will be a coating of fine horse manure left on the pavement, and as that dries it becomes loosened, and with every breath of wind it is distributed in the vestibules of houses, and in the pedestrians' eyes, and in various other places with extremely unpleasant results.

In Brooklyn, the sprinkling thus far has been done by private enterprise, and the cost has been about fifteen cents per week per house, with an average of eighteen or twenty feet frontage.

The city has, during the past year, been sprinkling some of the macadamized roads in the outlying wards, and I have some figures as to the amount of water that is used which mav be of interest. We have endeavored to simply dampen, or moisten the streets, and not actually drench them, as is commonly done. These roads are very popular for bicyclists, and for drivers, and we have found an ordinary sprinkler comfortably cares for two miles of macadamized road, with a tank holding about 200 gallons, and consumes 6,000 to 7,500 gallons per day per mile. Our meter rates being seven and one-half cents for 100 cubic feet, the cost of water consumed would be about sixty to seventy-five cents per day per mile. We have been paying for these sprinklers six dollars per day (which is certainly too much), that is, three dollars per mile per day, making the sprinkling cost us about three dollars and seventy cents per mile per day, or a little more than one cent per foot per month for each side of the street, assuming that sprinkling is done every day.

Now, I believe that with sprinklers owned and operated by the city, and with the water estimated at ordinary meter rates, the charge of sprinkling can be very materially reduced. The sprinkling privileges in Brooklyn are let to certain individuals by districts (fifteen, I think). It has frequently occurred when we have had the stone pavements repaired—one block in each of two districts. and another block several squares removed in a third district, all within a quarter of a mile—that the man who held this privilege for each district has presented a bill for six dollars per day for each of these short sections, which I have persistently declined to approve. This illustrates the evil and nuisance of letting out this sprinkling as a private privilege. It should be controlled, in my judgment, entirely by the city and done by day's labor, and consist of simply dampening the streets. Drenching should be absolutely prohibited, as well as any sprinkling whatever on asphalt pavements.

MR. JONES, Toronto: I fully concur in what the gentleman has just said, and, I may add, we control the service in the same way. It is done and paid for out of the taxes contributed generally by the citizens. We use fifty-two watering wagons of 500 gallons each, and I find that every wagon will cover about four miles of streets daily, sufficiently to allay the dust. We have eighty-five miles of single track allowance, which is watered by the electric car system, at a cost of eight and one-eighth cents per mile of single track; the entire track allowance being sprinkled four times each day.

My appropriation for the service this year was $25,000, exclusive of water. The sprinkling of the track allowance, and the residential and business streets, is all controlled by my department, all but the tracks being covered by the wagons I spoke of a short time ago.

Regarding the streets laid with asphalt, I quite agree with the gentleman here that it is not wise to water them at all. The only asphalt we sprinkle is the portion laid in the track allowance. As has already been stated, I find that it has a tendency to cause the horse droppings to cake upon the asphalt, which makes it difficult to clean, and when the water evaporates a great deal of dust arises. I was not aware that the question would come up in this shape, or I would have given you the number of miles covered this year by the service. I cannot do so from memory.

It is my experience that the problem of carrying out the street watering in such a manner as to satisfy everybody, is one of the most difficult that municipalities have to deal with. In my city it is, of course, impossible to cover the entire three hundred or more miles of streets we have four times daily, yet every householder imagines that a uniform service should be given, seeing that the cost is met out of a general rate, to which all contribute in proportion to the value of their property. I am firmly of the opinion that the best possible results are obtained when the work is done by day labor under the control and supervision of a municipal department, rather than by the contract system, but even then complaints will be made. My plan, in such instances, is to make a thorough investigation, and if the complaint is at all remediable we do our best to effect it. This service, together with those of street cleaning and garbage collection, are the most important that large municipalities have to deal with, having such close connection with the personal health and comfort of citizens, and they demand the very best attention. All three, in Toronto, are under the direct control of the city corporation. Personally, I am a very strong advocate of municipal control of public works, and franchises, performed by day labor, and in my city we have adopted that system very generally. Toronto is a favorite meeting place for conventions, tourist parties, and others, and the concensus of opinion amongst visitors is that we have a particularly clean city; one that is well attended to. I attribute this result largely to our system of employing day labor for the performance of important public services under the control and supervision of officers having charge of civic departments.

MR. STAINSBY: I would like the gentleman to make one statement. Does he mean that they sprinkle outside the tracks, or just make that plain? and if there is any gentlemen here that have had any dealings with the railroad company with reference to sprinkling their tracks, I know all my friends would like to hear from them. We have that question up with us, and I would like to know just exactly what you pay.

Mr. Jones: We pay seven cents per mile, four times a day; that is, they have got to sprinkle the whole track allowance of eighty-five miles.

Mr. Stainsby: Not outside the track?

Mr. Jones: They sprinkle the double track allowance, sixteen feet six wide.

Mr. Stainsby: You sprinkle outside that?

Mr. Jones: We pay eight and one-eighth cents per mile single track, watered four times per day; that is, the company has to sprinkle the entire eighty-five miles of track allowance four times daily. They sprinkle the double track allowance of sixteen feet wide.

Yes; I sprinkle outside of that myself. If the weather is dry, or whenever I deem it necessary, the company has to run out the trolley sprinklers as I may order. Firstly, the company owns and controls the electric car. Secondly, I engage the man who has charge of the sprinkling apparatus, his wages being paid by the city, so that, with the exception of running the car, the track sprinkling is under the supervision of my department. We have found this to be a very effective method of watering the track portion, and it has given general satisfaction ever since its adoption four years ago.

Two years since, at a meeting of this convention, held in Cincinnati, I had the privilege of reading a paper setting forth the methods adopted by us in the carrying out of the various public services, including that of street sprinkling. I mentioned then that the electric car system of watering the track portion was in operation, and giving every satisfaction, and I have had no occasion to change my mind. Page 160. I desire to say that, by resolution of our City Council, I am authorized to invite this convention to meet in Toronto next year; I have received a telegram to that effect. I was not going to discuss this matter, but, if you will allow me a moment, I will read the resolution—"That the city delegates to the Society be instructed to invite the convention to hold its next meeting in Toronto, in 1898." However, as the convention has already decided upon Washington as the next place of assembling, I may be permitted to say, Mr. President, that I think you have made a good choice. We hope to be able to again extend our invitation next year, and shall be greatly pleased to have you visit Toronto in the following year.

I have a few small pamphlets containing information about our city, and with your permission I will distribute them amongst the members.

MR. STAINSBY: You furnish the water free?

MR. JONES: Yes, sir.

MR. STAINSBY: And then pay them seven cents a mile?

MR. JONES: Yes, sir.

MR. STAINSBY: We think we do pretty well for the street railroads when we furnish water free to them without paying anything for sprinkling.

DR. HESS: I would like to know of Mr. Benzenberg if the estimate of two and thirteen one-hundredths cents estimated in those specifications was per day or per year.

MR. BENZENBERG: As I understand the article, it is two and one-tenth cents for the season, per foot front—not lineal foot of the street, but foot front on each side. That would make it four and twenty-six one-hundredths cents per running foot of street per year, or for the season, running from April to November, I think.

DR. HESS: In the city of Cleveland I have the misfortune to live on Euclid avenue, and there we pay two cents per day per lineal foot. on each side. (Laughter.)

I would like to say that my colleagues from the city of Cleveland tell me that I am mistaken, but I have the misfortune to pay the bills, gentlemen, and I know what I am talking about; I pay two dollars and forty cents every four weeks for the sprinkling in front of my house. I have fifty feet frontage. I might say that the contractor is liberal enough to sweep the streets for us twice a week; we get three and four sprinklings a day, depending, of course, on the temperature of the weather. About a week ago I began to feel that the exchequer has been running low, and I made some inquiry of my neighbors and I found that was the uniform rate, and when Mr. Benzenberg read in his paper that it was two and thirteen one-hundredths I concluded we had a pretty good contract per day.

MR. ROSEWATER: What material is your street paved with?

DR. HESS: Block pavement; and I said to the President of the City Council, I thought we had a very good contract at at two and thirteen one-hundredths per day, and he said, "six, sir," and I said no, six per day—evidently I am getting my leg pulled.

MR. ROSEWATER: How wide is your street?

DR. HESS: We have a sixty-foot street.

THE PRESIDENT: I may say, in that connection, when I spoke of Cincinnati a few minutes ago, our rates there are nearly the same as Cleveland; a twenty-five foot lot pays fifty cents per month—it depends upon how many sprinklings, but for a twenty-five foot lot they generally charge fifty cents per month. In other words, they are required to pay as much in one month as they do in the city of St. Louis in eight months. Mr. McMath, when I spoke to him on this subject, told me that this includes the entire cost, such as making and letting contracts, the cost of making assesments, the cost of inspecting, and everything pertaining to the matter of street sprinkling is included in this cost.

DR. HESS: I should have said two-tenths a day for our frontage, so it makes it sixty cents a week for fifty feet front.

MR. BENZENBERG: That makes it two-tenths of a cent per day instead of two cents?

DR. HESS: Yes, sir.

Mr. Benzenberg: I would like to give the history of Milwaukee. We tried the contract system, and we have come finally to the day labor system. The first sprinkling done in the city was done by contract, and the water was furnished at the rate of forty dollars per month per wagon, the wagons containing from five hundred and fifty to six hundred gallons each. The city found that the service was entirely unsatisfactory, and the contractor endeavored to reduce the number of times of sprinkling by drenching the street, and thereby do away with the necessity of his passing over it quite so frequently; in other instances it was very slightly sprinkled, and in a short time afterwards, perhaps half an hour or so, the dust would be flying, and consequently there was a continuous complaint. After that the city was authorized by an act of the Legislature to do its own sprinkling. Wagons and tanks were purchased by the city, and men were hired with teams to do the driving and sprinkling; the water is taken from the fire hydrants. During earlier years, the cost of this work was assessed against the property fronting on the streets that were sprinkled. The streets to be sprinkled were determined by the Common Council, upon petitions from parties who desired to have streets sprinkled. The result was that in the interior wards ultimately all streets were called for to be sprinkled, and, in order to do away with the levying of a special tax, it was determined that in the interior wards, where all the streets were sprinkled, the cost of sprinkling should be a general charge on that ward, and paid out of the ward fund, so that the special assessment was eliminated. In the outlying wards, however, the matter of special assessments against the property fronting on the streets that would be sprinkled still continued. The city at present does not pay anything for the use of water. The cost is about one and one-half to one and three-fourths cents per front foot per season. That is, for the labor of sprinkling, which includes the repair of wagons. I do not know whether it includes the purchase of wagons—does it, Mr. Brockman?

MR. BROCKMAN: No, sir; it includes the purchase of wagons where the same becomes necessary from the wearing out of the old wagons and tanks.

MR. ROSEWATER: It makes no allowance for water, does it?

MR. BENZENBERG: No, sir; it makes no allowance for water. This year, I think, it was one and one-half cents per front foot. The sprinkling is done satisfactorily to all parties. Of course the complaint that has been made in other cities has also been made by wheelmen in Milwaukee, about sprinkling the street for too great a width, but now we leave a path along the gutter line unsprinkled, a narrow path. The asphalt is no longer sprinkled, because of the reasons that are given by others who have preceded me on this question, and also because the wheelmen very seriously objected to having the asphalt sprinkled, and, in some districts, we have flushed the asphalt at night. The paved streets are swept under contract, and we find that the washing of the asphalt pavement by a stream from a hose attached to fire hydrants costs practically no more than the sweeping during the night time and the sprinkling during the day time, and that it gives much better service.

A MEMBER: How often do you flush?

MR. BENZENBERG: Three times a week. We did flush twice a week, and they called for flushing three times a week.

MR. ADAM: Does that keep it clean?

MR. BENZENBERG: Yes, perfectly clean. The horse droppings are scraped up during the day continuously; it does away with the dust in sweeping, and does away with the complaint of the wheelmen during the daytime, of wet asphalt; it washes and cleans the asphalt pavement much more thoroughly than any sweeping can. We have a great many macadam streets crossing our asphalt paved streets, and consequently when they are sprinkled a great deal of mud is carried by the wheels on to the asphalt streets and dropped there, which creates dust which cannot, by any system of street sweeping we have been able to devise or contract for, be taken up without lifting a good deal of dust and distributing it through the air to either side. We have found that the system of day labor in sprinkling, controlling the sprinkling entirely by the city, has been the cheapest and most satisfactory. Very little complaint has come in, either of sprinkling too much or of sprinkling too little.

MR. BEACH: There is one point that has not been covered in the discussion, and that is the control of the amount of water put on the street. In Washington the asphalt streets are not sprinkled, as a rule—the only asphalt that is sprinkled is a portion of "F" street, the principal retail street, which is a little narrower than most of the Washington streets are, and the dust blows into the open store doors. That street is sprinkled, and is practically the only asphalt street in Washington sprinkled during the day. The macadamized roads are, of course, sprinkled, and the amount of water is regulated by requiring the sprinkler to have a certain number of certain sized holes per square inch, and there cannot be more than so much discharged. The tanks or water boxes, instead of being high, as many of them are in other cities, are made long and low, being tilted up a little, of course, at the forward end, so that the discharge when the tank is nearly empty or full varies very little, owing to the control given by the area of the discharge, and the amount of water is kept down, and the street isn't drenched: and if it happens to be particularly dusty, so that the amount of water is not sufficient, the cart is run back rapidly over the same track. I am not speaking of street sweeping, I am speaking of street sprinkling. Yes, we have both the hand sweeping and the machine sweeping. Where they are swept by hand they do not allow sprinkling by the machine—the negroes use the watering can; the machine sweeping is done entirely at night, and the street is sprinkled lightly before the machine is run over it. The street sweeper doesn't immediately run along after the sprinkler goes over it; sometimes he goes along half an hour afterwards.

MR. SHERRERD: The abuse of fire hydrants where they are used in filling street sprinkling carts, has been a source of constant annoyance to the Water Department in Newark. We have partially overcome the difficulty by using an auxiliary hose valve on the hydrants, for which we require a deposit by the contractor who does the sprinkling. I think the charge made for water is six dollars and fifty cents per cart, per week, for water furnished by the hydrant to these contractors.

MR. RUNDLETT: In reference to sprinkling asphalt streets, I fully agree with these gentlemen, that they ought not to be sprinkled at all. In St. Paul on our residential streets we do not sprinkle at all, but they are kept clean by hand sweeping. In the business portion they are also swept by hand but on account of the dirt being blown in from other streets we cannot keep them clean to the satisfaction of the business people, and are obliged to sprinkle. Next season I intend to try washing with a fire hose instead of sprinkling. In Washington, where their prices are about the same as ours, they are under civil service rules, but in Minneapolis, where the city does the sweeping, the cost is nearly double what it is in St. Paul.

THE PRESIDENT: Before adjourning, Mr. Kennedy desires to make a statement.

MR. KENNEDY: We were received, as you know, two years ago in Cincinnati very cordially and magnificently, and a year ago at Chicago; we have not recovered from that reception in Cincinnati yet. It has been our earnest effort here in Nashville to receive you as kindly as we can, although, of course, we cannot be as magnificent in our reception as Cincinnati. Our people here are all very busy with the Centennial, and with their various duties, and there is a municipal election on hand right now that comes off next week, in which your humble servant is interested, and this has contributed to keeping me away from our meetings more than I otherwise would have been. But, as I said to you last fall, we will make no apologies; I trust up to date there is no necessity for any. Last night, according to our printed programme, it was arranged to give us some fireworks at the Centennial, the night on which Major McCann said he was going to set Mr. Hermann afire; on yesterday, Major McCann wrote me a letter saying "it was impossible to have any fireworks on Thursday night on account of the King's Mountain exercises, the Bellstadt-Ballenberg concert from four to six, and the Liederkrantz Society from four to eight, and the Bellstadt-Ballenberg again from eight to ten. When I spoke to you saying we would have Mr. Herrmann's picture in the fireworks, I thought we would have our usual fireworks on that night. We cannot have so much in one day; if we had the fireworks, we would be able to have Mr. Herrmann's face in it." I went out to see our German-American friends and the officers of the Centennial, and it was determined that this Society should be recognized, and they postponed the fireworks until a late hour, to show this Society the courtesy that was exhibited last night. To-day at 2:30 o'clock, if you please, we will all go to Belle Meade, which is one of the finest stock farms on the continent, about ten minutes' ride. We will start from the station down here at 2:30; the railroad has kindly furnished us a free train, and you will be taken out there and brought back without any concern or trouble to yourselves. At 2:30, if you please, or five minutes earlier, I hope you will be on hand at the hotel, so we can go out together, and we will walk down to the station, and after we have spent a few hours there we will come back to the Centennial Exposition, and there, if you please, we will disperse, and we will allow you gentlemen to take the best care of yourselves you can; I know you are capable of doing it; take your time at the concerts, and at nine o'clock, or a little before nine, you can reassemble over there near what is called the Casino—it is easily found. Assemble there as near nine o'clock as you can conveniently, and we will take you up there and give you a supper—the programme says a banquet; that may be misleading; it will be an informal affair. It will give us an opportunity to eat some Tennessee chicken and beef, and to interchange opinions with each other.

As you know, the Exposition is there, and there are thousands of people there daily, and a great many of them do not belong to the American Society of Municipal Improvements—they would be better off if they did—and for the prevention of intruders, I believed it proper to prepare a little ticket, which savors somewhat of a meal ticket; it is not a souvenir, because it will be taken up at the door. I desire to give each of you gentlemen present one of these tickets of admission to the Casino. They are here ready for distribution. Before you disperse, I hope you will kindly let me deliver each of you a ticket, and then be prepared at 2:30, as I say, to go with us on that special train, and come back at five or six o'clock to the Exposition, and disperse until nine; at nine meet me at the Casino, and then go with us to supper.

MR. JONES: I might say, by resolution of Council, I am authorized to invite this convention to meet at Toronto next year. We have telegraphic messages now to that effect.

THE PRESIDENT: Mr. Jones, just pardon me a moment, before you make any extended remarks on this subject; the Society has already fixed the place of meeting for next year.

MR. JONES: I was going to discuss it, if you will allow me just a minute. The resolution reads, "that the city delegates to the Society be instructed to invite the convention to hold their convention in Toronto in 1898."

I must say you have chosen wisely in choosing Washington for the convention. We hope for the year after we will be able to extend the same invitation we tender this year, and that the association will accept it.

I have a few pamphlets—very small ones—with a little information about Toronto, and, with your permission, I will distribute them to the association.

THE PRESIDENT: The Secretary will be ordered to present a vote of thanks of the convention to the city of Toronto for the invitation.

MR. KENNEDY: This matter will be wholly informal to-night —nobody present but gentlemen.

The convention here adjourned until Friday morning, October 8, 1897.

FOURTH DAY, FRIDAY, OCTOBER 8TH, 1897—MORNING.

The Society was called to order at 10:15 a. m. by the President, Mr. August Herrmann.

THE PRESIDENT: Mr. Keating, of the Waterworks and Water Supply Committee, informs me that they have no report.

MR. KEATING: I am afraid I will have to ask the indulgence of the Society. As I told you yesterday, we had some correspondence about this matter, and finally succeeded in getting one or two papers prepared for the Society. After considering the matter this morning, we concluded it would not be fair to the Society to attempt to formulate a report at such a late date. In fact we have not much that is new to report since the last meeting.

THE PRESIDENT: The next thing on the programme is the report of the Special Committee. Mr. Stanley, Chairman of the Committee on "Abolishing of Railroad Crossings in Cities," has sent the following communication to the Society:

NASHVILLE, OCT. 8, 1897.

AUG. HERRMANN, ESQ., PRES. AM. SOCIETY MUNICIPAL IMPROVEMENTS:

Dear Sir: I regret to inform the Society that the paper on "Abolishing Railroad Crossings in Cities" is incomplete and not in shape for presentation as per programme. Member of committee Jackson, of Chicago, being out of office, much expected data has not been obtained. I have not been otherwise able to secure information that would enable me to fully prepare a paper such as this subject deserves. Trusting that failure on my part to respond will be overlooked by the Society and my apology accepted, I am, yours with respect,

W. J. STANLEY.

THE PRESIDENT: I may say, in that connection, that Mr. McMath was on the committee and is not here, and so probably it is a case of "no paper" from the committee.

THE PRESIDENT: We will take up the next report, that of the Committee on "Coating of Cast Iron and Steel Riveted Pipes," by Mr. Benzenberg, of Milwaukee, Wis.

MR. BENZENBERG:

TO THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS:

Mr. President and Gentlemen: Your Committee on Coating of Cast Iron and Steel Riveted Pipes beg leave to submit the following report:

In order to obtain most of the information to be had upon the subject assigned to this committee, the undersigned were of the opinion that the best method to follow would be to address the Chief Engineers or Superintendents of the Water Works of all the principal cities in the United States and Canada. A circular letter and a list of twenty-nine questions upon the above subject were therefore sent to the Water Works officials of ninety cities and also to a number of inspectors at different pipe foundries.

As the treatment of the cast iron and the steel riveted pipes according to present practice differs materially, each will be taken up separately in this report.

To the list of questions sent out, forty-nine replies were received and from these it was quite evident that, although a few have given the matter considerable attention and study, generally the officials have given no especial consideration to the subject of coating cast iron pipe.

Some specify the use of Dr. Angus Smith's varnish, a few specify a coal tar pitch coating, while the majority depend entirely upon the foundry supplying some kind of a proper covering to the cast iron pipe. In but very few instances is any system of supervision or inspection as to the composition of the coating material or its method of application at the foundry maintained, and hence no assurance is had that the coating specified is really applied or that the covering which is applied possesses any merit as such, notwithstanding that upon the coating largely, if not entirely, depends the freedom from corrosion of both exterior and interior surfaces of the pipe and ultimately the delivering capacity of the same.

It is undoubtedly due to this trusting to luck policy that so limited attention has been paid and so little investigation been given this subject.

In the earlier use of cast iron pipe for distribution of water the same were not coated. Time, however, demonstrated that the metal, especially where the water delivered was soft or alkaline, rapidly corroded, and that by tuberculation of the interior surface, the diameter of the pipe was being materially decreased, particularly in small pipes, which were almost entirely closed by the incrustations. The quality of the iron, however, had much to do with the rapidity with which it was affected, as inferior or impure iron will submit much quicker to the action of oxygen and moisture or organic compounds in the water.

Mr. J. C. Trautwine, Jr., Chief of the Philadelphia Water Bureau, states, "that in 30 to 45 years' use of uncoated pipes, those three inches in diameter are almost closed, four inch pipe is a little less affected, and six inch pipe, in 74 years' use, shows a reduction of the internal area of about 20 per cent., without any appreciable diminution of the thickness of metal.

"A 22-inch main, laid in 1819, and removed March 23, 1897, during the construction of the Pennsylvania Avenue Sub-railroad, shows a reduction of internal area of only 4 16-100 per cent."

Mr. Dexter Brackett, Engineer Distribution Department of the Metropolitan Water Board, Boston, writes: "The uncoated iron pipes laid (in Boston) from 1848 to 1868, are in all cases coated from ¾ of an inch to 1¼ inch thick with tubercles. During the past 20 years, many of the uncoated pipes laid in 1848 and 1850 have been taken up for various causes. These pipes are in all cases badly tuberculated, but where the pipes have been laid in good clean soil, the iron is good and the thickness of the pipes does not appear to have been appreciably reduced."

The experience with uncoated pipes in New York, Brooklyn, St. Louis, Buffalo, Harrisburg, Detroit, Cleveland, New Orleans, and other cities, was in every respect similar to that in Philadelphia and Boston.

The protection of the iron pipe against rust, therefore, became a matter of early investigation which resulted in Germany in coating the interior of the pipe with a thin enamel, and in France in the process of dipping the heated pipe into a hot mixture of linseed oil and bees-wax, while in England Dr. Angus Smith patented in 1850 and used a process which has ever since been generally considered as the best protection for cast iron water pipe.

In the application of either of these methods the absolute necessity of removing all sand, earth, or other impurities from the metal of the pipe before coating, was well understood and especial care was taken to ensure the perfect cleansing of the pipe even to the removing of every particle of dust.

Where the pipe could not be immersed immediately after such cleaning the same were thoroughly covered with linseed oil to protect the same against rust until the same could be coated.

The Dr. Smith process of protecting cast iron water pipe was first introduced in this country in 1858, by Mr. J. P. Kirkwood, requiring its application to water pipe for the city of Brooklyn, and the closest attention to the perfect cleaning of the pipe was specified and exacted by strict inspection. This was an essential condition in the Dr. Smith process, which required the dipping of such pipe when heated to a temperature of 300 degrees Fahrenheit in a bath heated to and maintained at the same temperature. This bath consisted of coal tar pitch, from which all naphtha had been removed, until about the consistency of wax when cold, mixed with five or six per cent. of linseed oil. The pipe was required to be kept in this bath for some time, often as long as thirty minutes, before being withdrawn. It was also required that the tank be emptied occasionally and a new bath prepared with fresh material.

When this method was carefully followed, where no impurities or rust was permitted to be covered by the coating and where the metal was thoroughly coated so as to leave no blisters or uncoated spots, the protection was and is as perfect as any in use. Undoubtedly, under the rigid inspection which was enforced when this coating was first applied in this country, the best possible results were obtained and corrosion or tuberculation was prevented until in the course of time, where the conditions were favorable, the coating itself was affected or removed by the water or its chemical constituents, thus leaving the metal exposed to the action of the water.

In Charleston, Louisville, Harrisburg, Rochester, Philadelphia, and other cities, an examination of the pipe clearly revealed that the internal coating in many instances, when the pipe had been in service from 20 to 30 years, had partly or entirely disappeared or been worn off by the solvent action of the water. This, however, may have been partly due to less vigilant care at the foundries in the application of the Dr. Smith process than has been practiced in England, where, after 45 years' use, the coating was found to be as bright and clean as when first applied.

The permanency of the external coating also very largely depends upon the nature of the soil or material surrounding the pipe, ashes and cinders, for instance, very rapidly destroying the coating, which is followed by a pitting of the metal very similar to that caused by electrolosys. Numerous instances of such deterioration due to coal ashes or mineral salts in the soil, have been observed in Birmingham, Harrisburg, Elmira, Milwaukee, Los Angeles, St. Paul, and other cities, in some instances necessitating the substituting of new pipes.

It is, therefore, very apparent that, though the pipe may have been coated with what is known as the Dr. A. Smith varnish with a great deal of care in order to make the covering in this country complete and perfect, it does not always guarantee a permanent protection against corrosion or tuberculation, though it may greatly delay such impairment.

The coating most generally used by the different pipe foundries at the present time varies, some using ordinary coal tar without heating into which the pipe, heated to a temperature between 300 and 400 degrees Fahrenheit, are dipped, remaining in the bath about five minutes. Other foundries use distilled coal tar mixed with dead oil in the proportion of about 3½ to one. This is heated to 300 degrees and the pipe, which are heated to about 400 degrees, are dipped into it from ten to fifteen minutes. Others again use coal tar pitch heated to about 320 degrees into which the pipes, heated to same temperature, are dipped, remaining in the bath from 5 to 12 minutes.

Many of the foundries, however, do not exercise the care necessary to remove all the dirt, dust or rust before dipping the pipe and hence the varnish does not come in contact with and adhere to the metal uniformly and throughout every point of the surfaces, and the coating is therefore necessarily imperfect.

During the dipping process, small blisters are formed or the dirt particles are coated, which, while the pipe is being drained of the surplus varnish, are punctured or carried off with the varnish into the tank, leaving the pipe uncoated at these points. Many of these may not be as large as a pin head, yet sufficient to cause incrustation in some form thereafter.

There are but few cities that do not report some tuberculation along the inner surfaces of the water pipe, the cause for which is most generally assigned to imperfect coating.

The following quotations from reports made to your committee clearly represent the conditions and conclusions in all other cities where careful examination of the tubercular formations have been made.

Mr. E. Kuichling, Chief Engineer of the Rochester Water Works, writes: "The main point of my experience with coatings for cast iron water pipes is, that there can be no uniformity in the ultimate composition of the coating material, because the same is constantly being distilled or evaporated by the application of heat, which cannot fail to alter its quality at different periods of time; also, because the composition of coal tar pitch which is produced by different establishments, or even by the same establishment, is more or less variable, because there is similar variation in the quality of the fluxing oil which is added to said pitch, both by the same and by different foundries. The consequence of this variation is readily seen on close observation of water pipes which have been in service for a longer or shorter period of time. I have seen pipe considerably tuberculated after only two years' use, and thence on to 10 and 20 years; and this observation pertains, not only to this city, where pipes made by nearly all of the leading foundries in the country have been used, but also to a number of other cities in this country and in Europe. It has also happened frequently that of two pipes made by the same foundry during the same season, or perhaps even coated during the same week, or day, one will exhibit tuberculation in two or three years while the other may be practically free therefrom for ten years and upwards.

"There is an excellent opportunity for such observation in this city, inasmuch as the rock is near to the surface of the ground in several districts, and when new house connections are made with sewers the main is frequently broken by the blasting. An examination of the broken pipe and the adjacent pipes by reflecting sunlight therein has amply demonstrated the truth of the foregoing statement with regard to tuberculation, since the broken pipe may be free from any growth, while one or more of those adjacent thereto will exhibit tubercules in large quantity; it being understood that in these cases the pipes were made by the same foundry, in the same season, and were laid at the same time. There is accordingly, in my opinion, much room for improvement in the coatings of cast iron pipe. I would also add, that there is a marked difference in behavior of the same coating on the inside and outside of such pipes."

Mr. D. Brackett, of Boston, in reporting his observations, says: "It seems to me, that the failure of the coating to protect the pipes from rusting, or to prevent tuberculation, is due to the presence of minute holes in the coating. On carefully removing a tubercle from the interior surface of the pipe, the coating will often appear to be as perfect as when the pipe was first laid, but by means of the sharp point of a knife a soft spot can be detected in the iron of the pipe under the center of the tubercle. The hole through the pipe coating may be too small to be visible to the naked eye, but if it is large enough to permit of moisture reaching the surface of the iron, tubercles will form."

Though such tuberculation may not always seriously impair the strength of the pipe, yet in time it greatly diminishes its delivering capacity.

Mr. Desmond Fitzgerald, resident Engineer of the Boston Water Works, in 1894-95 made some very careful tests of the delivering capacities of two parallel lines of 48-inch cast iron pipe connected with the Sudbury Supply.

These pipes had been coated by the Dr. A. Smith process and had been in service for 16 years. Upon examination, both lines of pipe were found to be covered with tubercles to the extent of about one-third the interior surface, some of which were half an inch in height. At each of the great number of tests made, the loss of head was carefully observed while the volume of water delivered at different velocities was most carefully measured. These tests were made with each line of pipe in its natural or tuberculated condition and again after the tubercles had been removed and the pipe thoroughly cleaned. Briefly stated, the tests showed conclusively that the capacity of the pipe had, by the removal of the tubercles, been increased thirty per cent. and nearly restored to what it had been originally.

This large percentage of loss in capacity naturally increases with the decrease of the diameter of pipe similarly affected. It is therefore not only necessary to ensure the strength of the pipe, that the coating protection should be of a permanent nature, but it is also of the utmost importance in order to maintain the capacity of the distribution and delivery in an entire pipe system.

It is hardly necessary to call attention to the fact that the continuously growing demand upon a water supply, as well as the extension of water distribution systems, require that the entire original capacity of such system be carefully maintained and that, if by any inadequate method of protection such capacity in the course of time when the same becomes of greater value is endangered to the extent of 30 to 50 per cent., it is well worth the time and money to perfect the method or process of protection, especially when it refers to that part of a water supply which, because of its location and service, cannot be frequently examined or inspected as to its condition. What these shall be, your committee is not prepared to state, though they are convinced that there is considerable room for improvement on present methods.

Certainly greater care should be exercised in cleaning the pipe before dipping, and in case the pipe is not immediately dipped, it should receive a coat of linseed oil.

Your committee believes that with the present methods in vogue, only the very best coal tar should be used, distilled at a temperature of 440° Fahrenheit, in order to evaporate all the light oils and retain the creosote or heavy oils.

To this about five per cent of resin should be added to cut the residue and give tenacity to the varnish, which should be heated up to and maintained at a temperature of about 275° Fahrenheit in the tank.

The pipe ought to be heated to a temperature of about 300° Fahrenheit, then immersed for a period of not less than ten minutes, then thoroughly drained and dipped for a second time to ensure the coating of such points as may have been uncovered by the draining off of the varnish. As the dip in the tank thickens an amount of heavy oil sufficient to restore the uniformity of the composition should be added.

Your committee also believe, that as rigid an inspection of this part of the work should be enforced as is done in the testing of the pipe, being in their opinion of equal importance to the utility and durability of the pipe.

The necessity and importance of positive protection will undoubtedly be more appreciated as the condition of the pipe becomes better known, and further investigation possibly may result in producing some process of greater merit without a very great increase of cost. Quite a number of experiments with different kinds of varnish have already been made by various parties, but without satisfactory results and the coal tar varnish must be accepted for the present as the best, providing it is applied with care.

In the use of wrought iron or steel pipe, the question of a proper protective coating becomes one of still greater importance, because either metal is so much easier affected by corrosion than cast iron and at the same time has so much less thickness of metal to resist such corrosion. It is for these reasons, undoubtedly, that much more attention has been paid to the proper coating of wrought or steel pipe than to cast iron.

Wrought iron or steel pipe has not been in use long enough to give that test of time had with cast iron, but sufficient has been had to impress the necessity of some better methods than have been used in the past.

Along the Pacific coast where this kind of pipe was first used, asphaltum as found locally in its natural state, or a pure grade of refined asphalt broken into small fragments with the interstices filled with best quality of maltha, heated to a temperature of 280° to 350° Fahrenheit, was generally applied. The pipe was dipped into this bath for 20 minutes or long enough for the pipe to attain the temperature of the bath. After the pipe was withdrawn and the coating allowed to stiffen, it was again immersed for a short time to thicken the coat.

This same process has been largely followed in the East, excepting that, in order to shorten the time of the pipe in the bath, the pipe was slowly heated before being immersed the first time.

Pipe thus coated has largely shown upon examination, especially along the Pacific coast, that the coating had cracked and peeled off and in other instances had deteriorated and worn off, leaving the metal exposed.

Coatings of refined Trinidad asphalt, mixed with coal tar and coal tar pitch, or of coal tar pitch, mixed with linseed oil and dead oil of petroleum, have given equally unsatisfactory results. All the coatings seem to lack the quality of adhesion to the metal and would scale off under the blows of a hammer. A peculiar phenomenon of the above coating reported from different places, was its shrinking and cracking when exposed to the air after a long period of immersion in water. Maltha coatings failed in the same way when exposed to the air for some time.

Some large steel riveted pipe covered with three coats of pure red lead and linseed oil has, after only a few years' service, shown up very badly, likewise pipe which was coated with vulcanite varnish, was found to be badly pitted under the tubercle.

A forty-eight inch steel conduit pipe which was heated and dipped into a mixture of coal tar, lime and salt, was reported after twenty years' service to be in perfect condition, the coating being unaffected.

Another large steel pipe was dipped in asphalt dissolved in carbon-bisulphide, which is said to have so far proven quite satisfactory, the coat being tough and unaffected by long exposure to the sun or the air. This coat was applied cold, but the fumes, which come off for a long time, are said to be quite dangerous to the workmen engaged in the field rivet work.

During the past few years the "Sabin Process" baked coating has been used to protect steel conduits and pipe lines.

Since the interior deterioration of steel pipe, by tuberculation or by affording a foothold to vegetable growth, diminishes the delivering capacity of the pipe as effectually as tuberculation in cast iron pipe, Prof. A. H. Sabin concluded, that the only safe way to protect such pipe was to apply a special baking japan which would adhere to the metal with tenacity and possess sufficient elasticity to yield to indentation with the metal itself besides having great durability.

He, therefore, prepared such a compound into which the pipe was dipped, drained and then put into an oven and baked at a temperature of 400° to 600° Fahrenheit, for several hours.

The coating is thin and smooth and said to be quite continuous, elastic and adhesive and to have successfully resisted injury by handling or transportation. Where the surfaces were abraded by the field riveting the same were covered by a brush coating not baked on. It is reported that extreme care must be exercised in maintaining a proper and very uniform temperature during the baking process to always get satisfactory results.

As to the durability of this coating, nothing definite is as yet known as it has not been in use sufficiently long to stand the test of time. It is reported that at an examination made quite recently of a steel pipe coated by this process, the coating seemed to crack into flakes which could be peeled off, disclosing more or less rust on the surface of the metal, which doubtless was the cause of the coating not adhering and points to the necessity of the most rigid inspection at the pipe works. This is not only true as to this coating, but applies to any kind of covering used on either wrought iron, steel or cast iron pipe and too great care to have such pipe absolutely clean and free from all rust, cannot be exercised, even if it should necessitate pickling.

Another coating applied of late, is called Mineral Rubber Asphalt coating. Under this process the pipe is heated to a temperature of 300° Fahrenheit and then dipped into a bath consisting principally of Utah asphalt prepared by the Assyrian Asphalt Company. The pipe is said to be dipped twice and the coating to be 1-16 to 3-32 of an inch thick, elastic and tenacious.

As a paper upon this coating is to be submitted at this session, the writer of which is now extensively using said coating, we will receive some valuable information regarding the same.

Your committee, in presenting their report, have not attempted to submit any original process, but have endeavored to report upon the methods that have been adopted to protect the pipe metal with whatever success or failure that has been experienced with the different coatings, and hope that they have been able to impress those interested, with the necessity of the most careful study and inspection so essentially necessary to protect fully the utility and durability of the underground part of our water works systems. To what extent such part of the works are already impaired, no one can tell, but doubtless sufficient to warrant careful investigation and attention to the subject of pipe coating.

In closing, the undersigned desire to herewith express their appreciation of the courtesy and aid extended them by all those who have kindly answered the questions and given the benefit of their observations.

Respectfully submitted,
G. H. BENZENBERG,
M. R. SHERRERD,
L. W. RUNDLETT,
Committee.

ANDREW ROSEWATER: Mr. President, I think the Society, as here represented, will every one appreciate the amount of labor that has been brought out in the compilation of a paper upon this subject. That is a very important subject. In listening to the conclusions of the gentleman in his article, I notice that one factor connected with the observation of the results upon the pipe seems to have been so far omitted, and that is the question of the velocity and character of the water. In the first place, every one will admit that the chemical character of the water might have an influence upon the pipe, and if the water carries sand or other sediment with it, the question very largely will come up as to what influence the velocity of the flow of that water in the ordinary usage will have on the pipe. If the water is running at a high velocity and the discharge contains a large amount of sediment, it is natural to infer that the sediment will cause erosion inside, but, on the other hand, if you have a very low velocity, another result will follow and that will be the precipitation of material which will ultimately accumulate and choke it up.

I think it would be very interesting to further pursue this investigation and determine the variety of velocities through the various pipes so as to make a comparison of results. As Mr. Benzenberg has illustrated, there were two pipes, for instance, laid at the same time, no shade of difference whatever in their material, except the influence of the flow upon the coating. The result found would naturally follow in several years—if the water was discharged at a high rate of velocity in one pipe and in the other at a low rate—of course those are small factors, but it occurred to me, in listening to the article, it would be very interesting to pursue this investigation as far as possible.

MR. PIERSON: Mr. President, it might be of interest to the members of this Society connected with the water works and the committee's report about the cleaning of the inside of the pipe, to say that I had, a few years ago, occasion to visit a concern in Louisville that manufactured a large quantity of cast iron soil pipe, and was much surprised to find that, in cleaning the pipes, I saw what I never saw before in my life. They used a sand blast, had a pneumatic presure, adjusted in such a way that they could force the sand against the inside of any piece of cast iron in such a way as to absolutely polish it. It was very economical. I just want to mention it. I think it is one of the first places in the United States where they used sand blast for that purpose.

Mr. Keating, Toronto: I do not think there is any question but that a preparation, or coating, such as is generally known at Dr. Angus Smith's, will preserve iron pipes from incrustation for a certain length of time. A few weeks ago I had occasion to visit the town of Sherbrooke, in the Province of Quebec, in reference to the transfer of the water works to the corporation. Incrustation in the pipes and consequent depreciation had to be taken into consideration, in determining the value of the works. In one of the streets we found pipes had been laid without any coating, while the others had been coated with coal tar pitch in the ordinary way, usually called "Smith's Preparation"—I think there is a good deal ot misapprehension as to what that preparation really is. I happened, some time ago, to meet a gentleman who was a personal friend of Mr. Angus Smith, and was informed that Mr. Smith was amused at the prominence given to his name, and the various mixtures which were being used and described as his. He couldn't describe exactly what the mixture was himself, but stated that he had tried a mixture of grease and coal tar with very good results but just exactly in what proportions, or whether any other ingredients were used or not, he couldn't tell, or rather my informant didn't know. However, I mentioned that in the town of Sherbrooke one pipe was examined that was found to be very badly corroded; it had only been laid about sixteen or seventeen years. I inquired and found it was an uncoated pipe, originally intended for a gas main, while in other streets where a coating of tar and pitch had been used, the pipes were clean and comparatively free from oxidation.

Regarding the best coating for steel pipes, this is a matter in which I am particularly interested. I am now laying a six-foot steel conduit out into deep water in Lake Ontario for a new intake pipe. On this question of coating coming up, I was somewhat perplexed to know what to do and how to apply any preparation or mixture that might ultimately be adopted. It was constructed in long lengths, varying from forty-five feet up to about one hundred and fifty feet. On one portion of the work it became necessary to remove a portion of a five-foot steel pipe which been laid some nine or ten years previously, and I thought this would be a favorable opportunity to see what effect Lake Ontario water would have upon steel. The pipe was found to be badly corroded. It had apparently been painted, originally, with some preparation of tar, nearly all of which had disappeared. There was, however, one peculiarity about this pipe which I had never noticed before anywhere, and that was that all along the longitudinal joints there was no incrustation at all, for about an inch and a half on each side of the longitudinal rivets. On examination, the surface of the iron appeared intact and as perfect as when the pipe was originally made. What is the reason? Why was that pipe not incrusted at the longitudinal joints, while the remainder was badly rusted and covered with tubercles? I could not detect any signs of any preparation or coating having been applied to the clean parts of the pipe; nothing remained but the original black oxide. Now this is a matter I only noticed about a month ago. I can't account for it, perhaps some one here can. Whether it was the process of fastening the plates there with the riveting and hammering of the pipe along the seams in the process of bending them down to make them fit tightly which caused this portion of the pipe to withstand corrosion, I do not know. The whole subject is an exceedingly interesting one, and I think the committee are to be congratulated for the manner in which they have treated it and thanked for the report they have presented.

I have had some experience with incrustation in water pipes. Some years ago I was living in Halifax, and the water supply of the city became very much diminished by the incrustation of the water pipes, and it became absolutely necessary to do something. It was quite a while before we found out what was the matter. I had excavations made and opened the pipes and found they were badly closed up by oxidation. The experience stated in Mr. Benzenberg's paper was my experience..

Three-inch pipes were filled up; you couldn't get your finger in them. In pipes twenty-four inches in diameter, there was, I suppose, three-quarters of an inch of incrustation. This seemed to be pretty large, and was the same all around the pipe internally. It was not a question of sediment at all. I gave the matter some consideration as to whether it was possible to clean out the pipes by automatic scrapers, and this was subsequently done, and the discharging powers of the pipes, of course, were greatly increased. So far as my observation goes, not only the quality of the iron has something to do with the question, but I think the quality of the water has still more. A couple of years ago, when I was in the city of Brussels, Belgium, I was surprised to find they used no coating at all for the water pipes, and they are not troubled with incrustation, which is due, I think, largely, if not entirely, to the presence of lime in the water. A very simple experiment will show at once the action of water on iron. If you take two tumblers of soft water and put a small quantity of lime in one and then place an ordinary wrought iron nail in each of the tumblers, you will find in twenty-four hours that there will be signs of the formation of rust on the nail in the soft water. The other nail, I don't now remember how many weeks I kept it in the water, but a considerable time, and it showed no signs of iron rust or oxidation at all.

MR. BENZENBERG: Mr. President, I was particularly impressed with the fact that of the pipes which were coated by the same foundry and laid down at the same time, some were showing corrosion and some were not. There is no doubt a great deal of tuberculation gets on the pipe, and it is largely due to the carelessness of the inspector, if there be one, or to the greater carelessness of the men at the pipe foundry. The foundry people seem to consider that the coating of pipe is a mere matter of form, and as possessing no great importance. They insist that it requires no great attention, that it is simply to give the pipe a glossy appearance. I think it is well that we hereafter impress upon them that it is a very essential feature in the future condition of the pipe, and that as much attention should be given to the coating as there is to testing the strength of the pipe. A great many of them do not even attempt to clean out the dust, but allow it to remain upon the inside surface of the pipe, and naturally the coating does not adhere to the pipe metal, but more or less to this dust, which soon peels off and exposes the pipe or metal to the water, which, if soft, will start corrosion.

THE PRESIDENT: The next thing is a paper that will be read by Mr. Rundlett.

MR. RUNDLETT: Mr. President, I have collected some information upon this subject at odd times, mostly by letters from engineers who have had charge of this work, and if we have time enough to treat of the subject further, I will give extracts from the letters on this subject, giving their experience with it.

COATING OF STEEL PIPES.

The following was submitted by Mr. L. W. Rundlett, member of the Committee on Pipe Coatings, as supplementary to the committee's report:

STEEL PIPES.

Riveted wrought iron and steel pipes first came into use in the Western States and Territories where they were used to convey water for hydraulic mining for long distances, and sometimes under pressure which cast iron pipes would not sustain, and as in that region there was an abundant supply of soft natural asphalt, this material was used for a protective coating and its use had been quite general.

More recently, soft steel pipes have been extensively used in the construction of large water mains. These pipes corrode much more rapidly than cast iron and with shells varying from ½ to ⅝ inch in thickness, if buried in the ground without protection, they would within a short time become worthless. It is consequently of much more importance than in the case of cast iron pipe, that their protective coating should be as good as possible, and of such a character that they can stand the rough usage of transportation, the variations of temperature, and the hammering to which they are subjected in being riveted up in the trench, as well as the chemical action of the water which they convey, and the elements of the soil in which they are buried. With these pipes, also, engineers have followed previous practice and required in their specifications that they should be dipped in some asphaltic compound. All chemists that have devoted their attention to the composition of asphalts are agreed that the asphalt passes by insensible degrees from a ' uid material very closely allied to petroleum, into true asphalt or solid bitumen. The more fluid kinds change into the more solid kinds by the loss of the vaporizable portion upon exposure and also by the process of oxidation, which consists, first, in the loss of hydrogen and, finally, in the oxygenation of a part of the mass.

The harder asphalts exist in great masses and are found widely distributed in different parts of the earth.

The toughness of asphalt is largely due to the more fluid constituents which are in the nature of mineral oils, and where asphalt is spread out it loses these by evaporation or otherwise and becomes friable, and easily falls to a powder.

In common practice it has been found necessary to make the asphalt mixture for pipe coating of two ingredients, the first being harder than it is intended the pipe coating shall be, and the other of the nature of a heavy mineral oil. The pipe sections are dipped in the coating material while it is very hot, at a temperature usually above 300° Fahrenheit.

The pipes are sometimes heated before being submerged, and sometimes not, and the length of time they are kept in the bath seems to vary from 20 minutes to an hour. When taken from the bath the pipes are allowed to stand and dry in the air until the coating becomes hard enough to allow the pipes to be handled.

The difficulty experienced with this mixture seems to be that at the high temperature that it is kept, the softer ingredient is constantly evaporated, leaving the residue in the tank progressively harder, and it is therefore necessary to continually add small quantities of the oily ingredient to maintain the material at the right consistency. As a result of the inability to keep the mixture of a uniform consistency, the variation in the hardness of the coating is considerable, as is also the thickness.

When these pipes are exposed to use, the elastic or oily ingredient is gradually removed, either by the action of the air, or the gases in the ground, or by water, and the coating that is left loses its toughness and is easily removed, or offers a foothold for tuberculation.

In addition to the method of dipping the pipe in an asphaltic mixture which is prepared in different ways by the various combinations of different kinds of asphalts and mineral oils, and allowing the coating to dry by exposure to the air, there is another process which has more recently been quite extensively used in coating large steel pipe for a portion of the water supply system of Rochester, N. Y., Cambridge, Mass., and Allegheny, Pa., known as the "Sabin Method."

Mr. Sabin describes his coating material as a "compound consisting of hard asphalt with other resinous matter, combined with refined linseed oil as an elastic ingredient."

The process of coating the pipe is given by Mr. Sabin in a personal letter, as follows:

"In the use of this process it is desirable, in the first place, that metal scale and all dirt should be removed as thoroughly as possible from the surface of the pipe which is to be coated. This may be effected in various ways, the most common being with the use of steel brushes and similar means. The pipe should then be dipped in a tank filled with liquid, and this tank should be heated from the outside by means of a suitable flue. In some cases this dipping tank has been heated by steam, but it has been found practically impossible to avoid leakage of steam into the vat of coating material, which is objectionable on many grounds. It is in all cases cheaper to use direct heat and has been found simple and entirely practicable. The dipping tank can be heated, if desired, by the waste heat from the ovens. In some cases the pipe sections have been heated before immersing them in the dipping tank. This is necessary if they are not already free from moisture, and there is no objection to the practice in any case. If not so heated they must be left in the tank a few minutes to attain the temperature of the liquid, which should be about 300° Fahrenheit. On removal from this tank they are allowed to drain for a minute or two, and are then quickly put into the baking oven having a temperature of about 400°, and are left to rest in this oven in a vertical position for two hours. In some cases these ovens have been heated by allowing the products of combustion to pass directly into the oven, but this has been shown to be objectionable and in all more recent plants the oven has been heated either by an exterior flue or by the introduction of air previously warmed in a suitably constructed stove. As there is no evaporation, comparatively little heat is required to maintain the temperature providing the walls of the oven are of sufficient thickness of brick or other non-conducting material. During the various steps of this process it is desirable that the pipe should be exposed to the air as little as possible, hence it must be carried on in a building to protect it from the weather and must be handled by suitable machinery with such rapidity as is practicable. A considerable amount of coating material will be inevitably carried over into the oven, but if the bottom of the oven is heated this material will run off and may be caught in suitable drip pans and put back into the dipping tank uninjured. It has been found practicable to keep up a process of this character for several months without serious interruption and without injuring the coating compound. It is claimed for this process that it affords a coating which adheres more intimately to the metal than any other, that the coating material possesses the highest degree of chemical stability, that the surface of the pipe is left very smooth so that it resists abrasion to a remarkable degree and it offers but little frictional resistance to the passage of water, and that it has been proved by its application to the very largest work which has yet been constructed, to be an entirely practicable and reasonably economical process.

Although the cost per pound of the coating material is much greater than that of the cheaper asphalt mixture, the coating is thin and comparatively uniform in thickness, which is never the case with coatings which are applied by dipping and cooling, and on that account the cost of material is probably not much, if at all, in excess of the earlier methods. The cost of handling is, of course, somewhat greater, but it is claimed that this is more than balanced by the greater durability and other advantages of the coating."

I have not been able to obtain any reliable information of the results of the pipe coatings on the pipes that were first used to carry water for hydraulic mining.

They were undoubtedly coated with some combination of California asphalt, prepared in accordance with experiments made at the time, of the materials available. The following extract from a letter of Mr. A. L. Adams, of San Francisco, Consulting Engineer and member of American Society of Civil Engineers, will be found very interesting.

"Regarding the use of steel pipes on this coast, they have, as you mention, been in use here for many years, the riveted steel pipes first coming into use in connection with placer mining operations. Since then their use has greatly extended wherever large pipes are required for conveying water under heavy pressures. From here this class of pipe, as you doubtless know, has grown into very general favor in the East, where the construction of large gravity pipe lines has been undertaken. This class of pipe, as well as the plain-welded pipe, has always been coated with the California natural asphalt when used in the West. In former years the rock asphalt was fluxed with coal tar. In recent years the coal tar has given way to natural liquid asphalt known as 'maltha,' while some of the different grades of refined asphalt are usually used instead of the natural rock asphalt. There is a great difference in the practice of engineers in regard to the nature of the mixture that is calculated to give the most satisfactory result. Then, too, the consistency required varies under different conditions of use. In my own practice, speaking in a general way, I usually employ a mixture of 'XXX Paving Cement' and the 'L Grade No. 3,' in equal parts, both brands being prepared by the Alcatraz Asphalt Company. These proportions are modified more or less in accordance with the prevailing temperature under which the pipe must be handled, and from time to time, as the mixture tends to become brittle from long continued boiling. Then, too, I have no doubt that equally as satisfactory results can be secured from a mixture of other grades and other brands. It is not possible to lay down any hard and fast rules in this matter, reliance being placed principally upon one's judgment and experience in its use. For this reason, results are usually specified in requirements rather than the means of obtaining them. Out here, we think that up to the present time there is nothing better as a preservative for large pipe, though, of course, all engineers are interested in 'Sabin's Process,' as used at Rochester and elsewhere in recent years. Asphalt leaves much to be desired as a pipe coating, however, as under trying conditions of alkali doby soil, steel pipes of, say 10 to 14 gauge, frequently go to pieces—rust out—in a very few years. In a case recently called to my attention, a pipe of No. 14 steel, rusted full of holes in 18 months. The most successful pipe preservative with which I have had experience is what is known as the 'kalamein' process, owned and patented by the National Tube Works, of McKeesport, Penn. This class of pipe has been much used in this country for distributing systems where freight rates made the heavier cast pipe prohibitory. It is an expensive process, and not applied to pipes of large diameter. You are probably familiar with its composition. I have frequently used it, and many samples taken up after nine or ten years' use show absolutely no corrosion and no tuberculation."

In the proceedings of the American Society of C. E., May number, in a paper by Henry Goldmark, M. Am. Soc. C. E., I find the following description of the coating of a six foot steel pipe constructed at Ogden, Utah, to convey water for an electric power company:

"The mixture used consisted of C grade California asphalt, with the interstices filled with the best quality of natural liquid asphalt maltha, not above 14° gravity Beaumé test. The mixture was melted and kept at a proper temperature by steam coils in the tank. It was found that a prolonged process of coating gave the best results, and for this reason nearly an hour was consumed in dipping each section, and gradually withdrawing it from the boiling mixture. The coating was smooth and glossy, and stood the necessary handling without much damage."

The following is an extract from a letter received from Mr. W. B. Patton, former City Engineer of Duluth, regarding the 42" pipe and intake pipe now under construction in that city:

"The steel pipe, manufactured for the city of Duluth, was coated by different processes. That manufactured by N. F. Hugo was coated with a mixture of Trinidad asphalt and dead oil, the proportions being varied according to the temperature at which the pipe was to be handled, a large percentage of oil being used when a low temperature prevailed, the object being to procure a coating which would not be brittle, and liable to fly off when struck in cold weather, nor become soft and running at ordinary summer temperature. Trinidad asphalt was selected after exhaustive tests which demonstrated that this asphalt, mixed with dead oil, was the only mixture that would comply with the specifications, viz., not brittle when immersed in ice water, nor soft at 100° Fahrenheit. The pipe was dipped vertically in the mixture at 300° Fahrenheit, and allowed to remain in the bath for about one hour. It was then taken out and allowed to dry for a short time, and again immersed for a few moments. The resulting coating was very satisfactory and has withstood very severe handling with little injury. The asphalt seemed to adhere very strongly to the steel and had a good gloss, and was smoothly spread. This coating has withstood exposure in good shape, and I cannot but think that it will prove satisfactory.

The pipe manufactured by the Carroll-Porter Boiler and Tank Co. was coated with California asphalt mixed with maltha. When first arriving here, this coating presented a very handsome appearance, resembling a japan, but it proved to be quite brittle at temperatures far above the freezing point and became soft and running at temperatures much below 100° Fahrenheit. I think that this coating has not withstood the weather as well as the Hugo pipe and especially where exposed to the sun it has run and left the pipe almost clear of covering. This pipe was re-dipped in coating, as required by the specifications, but, I think, the material was put on a little too thick.

We had a peculiar experience with the coating of the intake pipe. It was delivered last July, a year ago, and has lain on the skids until quite recently. When we came to examine it this spring, we found that there were a number of rust spots on the pipe, on its upper outside surface. Examining these, we found the coating loose for some distance around the spots, and on removing the loose portion found the steel badly rusted.

It was necessary practically to remove the entire coating from the upper half of the pipes, and re-coat them with a field mixture. The only explanation that I can offer for this result is that the coating was blistered by the sun last summer, that during the winter the contraction broke the blisters, and the moisture entering, rusted the pipe and penetrated under the coating around the blister."

I am indebted to the Pittsburg Testing Laboratory for the following interesting description of the coating of the Pittsburg intake, and the New Bedford water pipe:

"We inspected for the city of Pittsburg considerable heavy intake pipe, which was manufactured at Riter & Conley's works, and at the James McNeil & Brother works, Pittsburg. This pipe was dipped in asphalt dissolved in carbon-bisulphide, which gave a very satisfactory coating. The great objections to this coating are the fumes which are given off for quite a long period and which cause grave dangers to the men doing the field riveting. The Pittsburg line, however, had manholes in every fourth section, and as the covers were left off when the riveting was done, the fumes were not found objectionable, but in ordinary pipe lines where the manholes are only a thousand feet apart, the fumes would undoubtedly be dangerous to the workmen. The pipe was dipped cold, and at the end of five or ten minutes the carbon-bisulphide evaporated sufficiently to leave a gum-like coating on the pipe. Some of this pipe was laid in the sun for weeks, and the coating was not affected in the slightest. The coating was tough and not brittle. To the best of our knowledge this coating has given extreme satisfaction to the city of Pittsburg; at least, we have heard no complaints, and as we have done all their inspection for the past seven years, we are in a position to know if this coating had not been satisfactory.

The New Bedford water pipe was coated with Alcatraz asphalt, which is the most satisfactory coating we know of. This comes in two forms, the hard, which resembles, when broken, cannel coal, and the soft or flux, which is about of the consistency of printers' ink. These two are mixed in the dipping tank, the proportions being about three to one, or whatever is found to give the best results on a trial mixture. The mixture is heated to 300° Fahrenheit by the aid of steam pipes. Each pipe is slowly heated before dipped with a natural gas flame, in such a manner as not to injure the pipe, but heat gradually. This reduces the time the section has to remain in the tank about one-half. We find, this gives a tough coating, which stands the changes of the temperature well. The section of the New Bedford pipe which the writer witnessed tested in the trench, he particularly noticed that the coating just before the pipe was covered up, was in good condition. One or two sections, however, showed slight signs of flowing, having been in the intense summer sun. Undoubtedly, this was due to the fact that in replenishing the bath an excess of flux was added."

The first steel pipe laid for water supply was at Rochester, N. Y., and Mr. Kuchling, Chief Engineer of the Water works, has had a long and extensive experience in the use of this class of pipe. The following very valuable information given in a letter received from him, will, I know, be of great interest to the association:

"In regard to the coating of riveted steel and wrought iron pipes I would say that the chief point to be considered is the behavior of the coating under the rough usage of transportation and laying in place, whether the latter be accompanied by riveting operations or not. If the separate pipes are riveted together on the bank or on the bottom of the trench, the adhesion of the coating will be severely tested; and these several elements constitute the principal criterions for estimating the quality of the coating. Of course, it should also be insoluble and continuous on the metal, besides being plastic enough to conform to moderate deformations. Great thickness of coating is not always successful, because it will neither run nor flow when warmed by exposure to the sun, or even in warm weather; also because it then becomes more or less brittle and loses thereby its adhesion to the metal.

I have in my possession some samples of asphaltic coating ¾ of an inch thick, produced on the bottom of a pipe by flowing during transportation, which could easily be peeled off in flakes of one-half square foot to two square feet. In these cases the coating invariably showed cracks from the jars or concussions received on the car; and when two such pipes were riveted together, a wholesale loosening of the thick coating always resulted. The desideratum for a coating is, therefore, not thickness, but strong adhesion under rough usage, together with durability.

I have had extensive experience with asphaltic coatings made of:

a. Refined Trinidad asphalt, coal tar and coal tar pitch.

b. Preparations of coal tar pitch with linseed oil and dead oil of petroleum.

c. California asphalt.

d. In recent years, with Sabin's baked coating, or japan.

The three first-named coatings all exhibited the characteristics of flowing and lack of adhesion mentioned above, and they furthermore all exhibited lack of durability, as evidenced by cracking, by shrinking in the course of time when exposed to the weather, or on being dried after long immersion in water.

In illustration of this fact, I may cite the case of two 20-inch circular buttons or discs, which were cut out of the tops of two 36-inch wrought iron riveted pipes in the old conduit of the Rochester Water Works, after the same had been in use for about 15 years. The coating was, in this case, a mixture of nearly equal parts of refined Trinidad asphalt and coal tar pitch, with the addition of a small amount of liquid coal tar as a flux. When these 'buttons' were first removed the coating appeared to be continuous and sound, but within six hours the coating began to show fine shrinkage cracks which afterward increased greatly in size. It thus appears that coatings of this character must be kept continually immersed in order to retain their continuity, and that some ingredient has been dissolved in the course of time.

The same phenomenon has also occurred much more rapidly in the case of various coal tar pitch coatings with which I am acquainted. The California maltha coatings also show the same failing, and in some cases I have known the material to disintegrate entirely within a few weeks before being exposed to the action of water, so that it could be brushed off from the metal in the form of a coarse powder. Such maltha coatings were beautifully glossy while new, but they soon began to show fine surface cracks or reticulations, on exposure to the air, losing their gloss and becoming coated with a fine powder, dust or 'bloom,' similar to that of a plum. This dust or powder was of a brown color, and apparently bituminous in character, inasmuch as when collected upon a bit of cloth or paper and ignited, a faintly bituminous odor was believed to be observed. Furthermore, none of these coatings would stand the severe test of hammering without flaking off, even when exposed to a hot summer sun.

It may also be mentioned that when these coatings were applied, every reasonable precaution was taken to insure the freedom of the metal from rust and dirt, and its thorough dryness, inasmuch as before dipping the pipes were heated to a temperature of about 300 degrees, the bath being heated to about the same temperature or somewhat higher. It is easy to understand that asphaltic coating will not adhere to rusty, dirty, or damp metal, but when the metal is treated as aforesaid, it is difficult to appreciate why the coating does not adhere properly.

I may also mention, that when such coatings are soft enough to be easily indented with the finger nail, they will nevertheless frequently scale off easily when sharply hammered.

The Sabin baked coating, on the other hand, is a thin and strongly adhesive film, which is not loosened by hammering, or even by indenting the metal itself. By its use the area or surface which is destroyed by abrasion in transportation and handling is reduced to a minimum, so that such surface may be measured by the square foot in the case of the other coatings mentioned. Its durabilty has thus far been established only by laboratory experiments and three years' use on the new conduit of the Rochester Water Works, and less in other places. It is fair to conclude from all these experiments, however, that it will prove fully as durable as the thicker asphaltic coatings mentioned; but time alone can establish the facts. There is, therefore, little more to be said about it at present, beyond what has been published by Prof. Sabin in the pamphlet mentioned.

It may also be remarked in this connection that the subject of painting abraded surfaces on thin riveted metal pipes becomes of interest, inasmuch, as such damage appears to be unavoidable. Such a paint should practically dry rapidly and be convenient of application.

I have made many experiments during the past 20 years with a great variety of paints, but have not yet found any which were thoroughly satisfactory and met all the different requirements. I have therefore reached the conclusion that the best means of repairing moderate damages to the coating of such pipes, is to apply a hot mixture of refined Trinidad asphalt and linseed oil, or dead oil, to the abraded surfaces, with a brush or swab; and in case that the coating is extensively abraded or is otherwise defective, the whole pipe should be taken back to the factory and re-coated.

From the foregoing it is evident that much progress in the direction of coating both cast iron and wrought iron or steel pipes, is possible, and that both manufacturers, engineers, and chemists should unite in striving to reach an early solution of the problem. The principal point to be observed will manifestly be the securing of uniformity or homogeneity in both composition and mode of application; and so far as these conditions are concerned, they appear to be best fulfilled in the case of the japanning process, where bituminous and organic materials are used."

Mr. L. N. Hastings, City Engineer of Cambridge, writes as follows in relation to the Cambridge pipe coated with the Sabin process:

"The coating seemed to be a very satisfactory one, but I have never had an opportunity to uncover much of the pipe to examine it after it was laid, so I have not yet had much experience upon which to base an opinion as to its durability."

In the transactions of the American Society of Civil Engineers, of December, 1896, Mr. Hastings gives the results of some tests of plates which were coated with "Durable Metal Coating," which was used to resurface the injured portions of the pipe. Some plates were kept in running water a little more than a year, and some were buried in the soil. The following is a summary of the result of his experiments:

"Metal covered with a coating of sufficient thickness was well protected from action of water. The thinner coating did not prove so efficient a protection, while unprotected metal, subject to the same influences, suffered considerably from oxidation and action of the water, the plate iron being affected the most, steel plate to a less degree, and the cast iron the least of all."

The Minneapolis steel pipe was coated with a "Mineral Rubber Coating," composed of rock asphalt and maltha, which will be fully discussed in a paper by Mr. Cappelen, City Engineer.

The Newark steel pipe was under the inspection of Mr. Sherrerd, a member of the committee, and who will, no doubt, give you full information in regard to the coating of that pipe and the results to date.

In conclusion I would say that the subject of pipe coating is not one to which I have ever been called upon to give any personal study, and it is only since being put on the committee, and after making some personal examination of the steel pipe construction, that I fully realized the importance of the subject. In my efforts to be of some service to the chairman of the committee, at the last hour I have collected some facts from the experience of others, which I have presented, hoping that they may be of some interest and benefit to the Association.

MR. SHERRERD: Since the members of this committee live so far apart, we were unable to do much concerted work, and the report submitted is almost entirely due to the energy of the Chairman. There are, however, one or two matters I would like to mention, and one in particular in regard to the method of applying asphalt coating to steel pipe. Not long ago I visited a shop in Paterson, N. J., where riveted steel pipe is made. Mr. Milson, the proprietor, who has had considerable experience in this work, referred to the fact that the recent specifications required the bath to be arranged to dip the pipe in a vertical position. He told me he had been trying experiments by using the vertical bath, and found it very difficult to get uniform results, from the fact that the lighter oils would rise to the top of the mixture, the bath necessarily being so deep that there would be considerable difference in the mixtures between the top and the bottom.

Mr. Milson also spoke of his experience with the California asphalt which was used in coating the first line of forty-eight-inch riveted steel pipe for the Newark conduit. He said it was very difficult to keep the bath from caking, still they got fairly good results from this material, but not nearly as good as were obtained from the Assyrian asphalt, which was used on the second line for the Newark Water Works, laid last summer. Much of the pipe was coated at this shop. I examined different samples of these two asphalts, and found that the California asphalt, at least as shown by the sample at this shop, could easily be crumbled, while the Assyrian asphalt, in all its different stages, seemed to be tough and could be cut with a knife or hatchet, but did not crumble off like the other.

About a month ago I had occasion to go into the first conduit above referred to. This has been in use about six years. There was a slight growth of tubercles in this pipe. I found them about as large as my little finger. On the section of pipe examined, their number would average about one per foot, length of pipe. These tubercles were more numerous near the manholes, which was no doubt caused by the fact that the coating had been scratched more at these points of the pipe line by the men working on the line at the time it was laid.

Near one of the manholes I found a little blister, about as large as my finger nail, which broke under a slight pressure. Beneath this there was a small quantity of brown dust, which I believe corresponds with one of the higher oxides of iron which was shown in my paper of last year. This would be formed by heating the pipe before it is dipped, and would indicate that it is always essential that the pipe should be considerably heated before being immersed in the bath.

MR. BENZENBERG: Some may think that the recommendations of the committee in regard to the coating of cast iron pipes is one assumed off-hand by the committee. I have had a large number of the varnishes used by the different foundries analyzed by different parties with the same result. I also had a large number of the different kinds of coal tar, used by the different gas works of the country, analyzed and found that a uniform result could only be obtained by subjecting each one of them to a certain temperature at which the light oils should all be evaporated. It was found that at a certain temperature, that recommended by the committee, all the light oil would distill off, leaving all the heavy oils as required.

I find that in the coatings furnished and used by the different pipe factories they all vary; there are no two who use the same material.

In connection with steel pipe coatings, I beg the indulgence of the Society for a moment to bring upon the record of our proceedings a paper upon the subject of a coating which has been used and dwelt upon in a paper read by A. S. Humphries, of New York, before the American Gas Light Association at St. Louis in October, 1896. It has been highly spoken of since then, and he finally induced two houses to use the coating for wrought iron pipe. I will just read an extract out of the paper.

"During one of my first trips to Cincinnati I was discussing the question of service pipe protection with Gen. Hickenlooper, who told me that he was coating all of his pipes with a certain mixture, which had been put to a continuous test of six years in competition with all the other methods then known to him. In this test a number of complete sets of service pipes had been under comparison, each kind of coating being subjected to the action of a great variety of different soils and of moistening with a great variety of liquids. At the end of six years the one coating which had resisted all combinations of soil and moisture was the mixture he was then enjoying. This mixture they had then been using exclusively and continuously for ten years, and they found the results in practice to fully confirm the results given by their most elaborate, thorough, painstaking tests. I obtained his permission to use the method in my works, and later obtained his permission to use it in all works of the United Gas Improvement Co., and still later in other works which came under my supervision. I now have his permission to quote the details for the benefit of all interested.

So greatly have I appreciated the results thus obtained through the courtesy of Gen. Hickenlooper, that I feel I am doing a service to the members of this association in bringing it now prominently to their attention. The specifications given to me were as follows:

'Bring a kettle of tar (20 gallons) to a low boiling point, and add twenty pounds of slaked lime sifted over the top and worked down. Boil down to a paste, or a consistency of about midway between tar and pitch. Let it settle for a few minutes, then add four pounds of tallow and one pound of powdered rosin, stir until they are thoroughly dissolved and incorporated with the tar, then let it cool and settle. Ladle off into barrels. When ready for use, to each barrel of forty-five gallons of the mixture add four pounds of crude rubber, dissolved in turpentine to the consistency of thick cream. Heat the mixture to about 100 degrees F., and immerse the service pipe, heated to about the same temperature.'"

These are the specifications of the coating used. The coating costs about one-tenth of a cent per foot.

Mr. Rundlett: I have here some specimens of the California asphalt coating on pieces of steel. I tried to get specimens of all, but they were not all running. (Here exhibited specimens to the Society.)

The President: If the gentlemen desire, we will now have the next paper.

Mr. Rundlett: The paper of Mr. Cappelen?

The President: The next thing on the programme is a paper on "Tests of Coatings for Steel Water Pipe," by Mr. Cappelen.

TESTS OF COATINGS FOR STEEL WATER PIPE.

BY F. W. CAPPELEN, M. AM. SOC. C. E., CITY ENGINEER, MINNEAPOLIS, MINN.:

TESTS OF COATINGS FOR STEEL WATER PIPE.

As steel riveted pipe of large dimensions is being daily more and more used in the construction of water works, with their appurtenances, the question of protecting such pipe from corrosion becomes of more and more importance, and, in fact, is "the question." As the writer had occasion to prepare specifications and advertise for bids for about 31,000 feet of 50 inch steel pipe from 5-16 inch to ½ inch in thickness, the question of coating was to him of utmost importance. The writer, therefore, concluded to make some tests of various coating materials, the results of which are herewith submitted.

Five different materials were used:

No. 1. Mineral rubber asphalt from Utah, manufactured by the Assyrian Asphalt Co., of Chicago, Ill.

No. 2. Trinidad asphalt, mixed with dead oil, used by the Hugo Iron Works, of Duluth, Minn., for the new 42-inch steel pipe line in Duluth.

No. 3. California asphalt, from the Waldorf, Cal., mines, and

No. 4. California asphalt, same as above, mixed with about 40 per cent. of maltha, and, finally,

No. 5. Pipe dip from the works of Dennis, Long & Co., Louisville, Ky. Samples of number 1, 2 and 4 are herewith submitted.

To do the dipping test an oven was built of brick, and two 8-inch iron pipes bricked in so as not to be exposed on their inside to any smoke or flame. Into these pipes 4-inch pipes were placed to be heated to the desired temperature. These pipes were thoroughly cleaned by pickling in diluted acid before heating. The coating material was heated simultaneously, and when pipe and coating had the desired temperature the dipping of the pipe in vertical position was done: some pipes were dipped once, some dipped twice, the second dip being made quickly after the first, and thereafter the dipped pipe was either placed in ice water and allowed to cool therein, or was cooled without being put in water. After cooling the coating was subjected to blows from a hammer to test the elasticity of the material.

The following dip tests were thus made with

MINERAL RUBBER COATING.

Test
No. 1. Temp. of pipe 400° F.: of coating. 400°: pipe dipped twice then put in ice water.
No. 2. " " 400° F.: " 400°: " " once " " " "
No. 3. " " 300° F.: " 300°: " " twice " " " "
No. 4. " " 300° F.: " 300°: " " once not " " "

Coating covered pipe splendid in all cases and somewhat thicker for the 300° temperature and stood hammer test perfectly. The material is so elastic that, by cutting into the coating and entirely removing some of it, the opening can be covered by simply hammering the edges around the space so that it is impossible to see the joint. The coating did not foam even up to a temperature of 700° F.

TRINIDAD ASPHALT MIXTURE COATING.

Test
No. 5. Temp. of pipe 300° F.: of coating. 300°: pipe dipped twice then put in ice water.
No. 6. " " 300° F.: " 300°: " " once " " " "
No. 7. " " 300° F.: " 300°: " " twice not " " "
No. 8. " " 300° F.: " 300°: " " once " " " "

The coating remained sticky after coating, in all cases, evidently due to the dead oil. The hammer test was made some days later, showing some slight flaking, but at the same time indicating considerable elasticity. That the coating loses its stickiness must be due to evaporation of the dead oil.

The mixture when heated foamed considerably, evidently due to presence of dead oil and moisture.

CALIFORNIA ASPHALT COATING.

Test
No. 9. Temp. of pipe 350° F.: of coating. 350° F.; pipe dipped twice then in ice water.
No. 10. " " 350° F.: " 350° F.; " " once " " "
No. 11. " " 350° F.: " 350° F.; " " once not " "

Coating was very nice, but flaked badly for hammer test in all cases.

CALIFORNIA AND MALTHA MIXTURE COATING.

Test
No. 12. Temp. of pipe 300° F.; of coating 400° F.; pipe dipped twice then in ice water.
No. 13. " " 300° F.: " 400° F.; " " once " " "
No. 14. " " 300° F.: " 400° F.; " " twice not " "

This coating was very nice, but flaked slightly in all cases. The writer made this mixture himself, having had some experience with the two materials constituting the same. The high percentage of maltha is required to overcome the brittleness of the asphalt.

DENNIS LONG PIPE DIP.

Test
No. 15. Temp. of pipe 300° F.; of coating, 300° F.: pipe dipped twice then in ice water.
No. 16. " " 300° F.: " 300° F.; " " once " " "
No. 17. " " 300° F.; " 300° F.; " " once no "

Did not stand the hammer test.

Coating when hot foamed considerably.

In all cases, but particularly where the coating flaked off, a thin secondary coating could be seen next to the pipe. This same condition was found to exist on some of the New Jersey Water Co.'s 48-inch steel pipe for the Newark supply, when it was uncovered last year. Mr. Sherrerd, the engineer in charge of the Water Department of the city of Newark, N. J., considered this secondary coating to be a combination of sesque-oxide of iron with proto-oxide, or what would chemically be equivalent to $Fe_2\ O_3+FeO=Fe_3\ O_4$, a more stable compound which would prevent further oxidization, and is probably due to some chemical action which takes place when the hot pipe is dipped in the asphalt bath. Where nothing but this coating was found on the Jersey pipe line no further oxidization was discovered.

These tests were made April 21, 1897, and the writer again examined the pipes May 30, finding that all coatings had hardened very slightly.

Some twenty iron plates, about ⅛ inch thick and 6 inches square, were treated in a similar manner as the pipes with the same result. Tests were then made with various acids to see the effect upon the coating on the plates with the following result:

The Mineral Rubber Coating was not affected by muriatic acid (H CL), nitric acid ($H\ NO_3$), nor by sulphuric acid ($H_2\ SO_4$).

The Trinidad Coating was not affected by H CL, but was affected by $H\ NO_3$ and $H_2\ SO_4$.

The California and Maltha Coating was affected slightly by H CL, but very perceptibly by $H\ NO_3$ and $H_2\ SO_4$.

The California Straight Coating was not affected by H CL, but was affected by $H\ NO_3$ and $H_2\ SO_4$.

The Dennis Long Coating was affected by all three acids.

Finally the three best coatings were analysed with the following results:

	Mineral Rubber. Per ct.	California & Maltha. Per ct.	Trinidad Per ct.
Petrolene (soluble in petroleum ether)	75.71	70.66	43.08
Asphaltene (sol. in boiling turpent. & chloroform..	23.59	12.35	14.67
Total bitumen	99.30	83.01	57.75
Coke and organic matter not bitumen	0.49	2.61	21.58
Ash (mineral matter)	0.21	11.95	1.05
Moisture and volatile at 100° C.	.....	2.43	19.62
	100.00	100.00	100.00
Specific gravity	0.97	1.13	1.20

The analysis of the Trinidad mixture was very tedious and required several days' time. It was repeated to make sure of the result, which is correct as above.

Judging from these various tests, the writer is convinced that the Mineral Rubber Coating is the best and, judging from other information at hand, it is probably the best coating ever put on the market, not barring the so-called Sabin Japanning process.

The cost per ton is about: $60.00 for the Mineral Rubber.
45.00 " " Trinidad.
40.00 " " California & Maltha.

The specifications for the coating for the 50-inch steel pipe for the Minneapolis work was therefore made as follows:

Coating.—After testing to the satisfaction of the engineer, the pipe shall be thoroughly dried and cleaned, and heated in suitable oven to 300° F., after which they are to be thoroughly coated by dipping vertically in a bath of mineral rubber asphalt, manufactured by the Assyrian Asphalt Co., at Chicago, Ill., or such other material equally as good as the engineer may designate. (This to protect the city.) This coating must be smooth, hard, yet tough, elastic and durable; it must be free from blisters and bubbles. The bath must be heated in such a manner as to insure a constant and even temperature of 300° F., preferably by steam.

The dipping material must be kept free from sand, grit or other foreign material. To obtain this the contractor shall, as often as necessary, in the opinion of the engineer, empty the tanks of their contents and refill them with clean and pure material.

The work of furnishing and laying this steel pipe line with all appurtenances was awarded to the T. A. Gillespie Company, of Pittsburg, on the 18th day of June, and to-day all material has been shipped, and about 29,000 feet of pipe delivered and by the end of this month 30,000 feet will have been laid and tested.

The coating used is the one specified and the writer is very well pleased with the result. The coating is tough and elastic and does not easily abrade. Workmen can walk all over the pipe with impunity without hurting the coating. Precautions were, of course, taken to subject the pipe to as little abrasion as possible in the field.

The process of coating the pipes in the shop is as follows, and illustrated on the accompanying sketch.

The coating material is first put into the paint boiler and is boiled at 700° F.; it is then run into the dipping tank which is kept at about 400° F., by means of super-heated steam. From 15 to 20 barrels of coating is kept in the boiler all the time, and as the coating is used up, more is added. The coating is heated with natural gas and the heat must be kept up, without allowing the paint or dipping tank to cool, in order to keep up a uniform heat.

The pipe before dipping is heated with natural gas. Two 2-inch pipes 20 ft. long are run into one end of the section of pipe and one 3-inch pipe 7 feet long is placed in the other end. Holes are drilled in the sides of these pipes about 6 inches or 8 inches apart in order to send the gas out in all directions.

After the gas has been lighted, the ends of the section of pipe are closed with sheet iron and the pipe is quickly heated to the desired temperature, which is that of the paint in the dripping tank. This must be watched very closely as the best and most economical results are obtained when pipe and paint are of the same temperature.

This method of heating is better than by the use of an oven, and the pipe can be handled better.

After the pipe has been heated it is lifted by a heavy clamp bolted on one end and lowered into the vertical dipping tank; and it is kept in this tank 20 minutes and is then taken out very slowly and allowed to drip. It is then stood on end to dry, when it is ready for shipment.

The dipping tank is composed of a steel casing 68 inches in diameter enclosing the tank, which is 66 inches in diameter and is lined with steam pipes running vertically, and about 8 inches or 10 inches apart, between cast iron rings at top and bottom. There is also a steam cylinder 30 inches in diameter in the middle of the tank.

The steam is super-heated in a gas furnace and must be kept at a high temperature and is consequently under great pressure. The temperature is about 900° F.

Some sections of pipe were weighed before and after dipping to determine the amount of coating used. Each section was 28 feet long, the pipe being 50 inches in diameter.

Weight of ⅜-inch pipe before=6,800; after 6.950.
Weight of 7-16-inch pipe, before=7,880; after 8,020.
Weight of 5-16-inch pipe, before=5.745; after 5.905.
Weight of ⅜-inch pipe, before=6.750; after 6.900.
Weight of 7-16-inch pipe, before=7,825; after 7.975.
Weight of ½-inch pipe, before=8,900; after 9.050.

This makes an average of 150 ℔s. of coating per each section of pipe of 28 feet, or about 5.5 ℔s. per lineal foot.

On the East Jersey pipe lines, also built by the T. A. Gillespie Company, in 1896, about 75,000 feet of 42-inch and 48-inch, manufactured at Paterson, N. J., were coated with the same material as used in Minneapolis, but the pipe was dipped horizontally.

It has been demonstrated that the vertical dip is the only proper method. The coating is smooth and evenly distributed.

With the horizontal dips a great deal of surplus material would lodge in the bottom of the pipe.

F. W. CAPPELEN,
City Engineer, Minneapolis, Minn.

Mr. Herrmann: Mr. Chairman, as there is a special committee on this subject, and which is a very important one, I now make a motion that this committee be continued for another year, and that the President be authorized to appoint members therefor.

Motion seconded and carried.

Mr. Farnham: I would like to ask the members for their experience with paints for iron and steel work, painting about water pipe connections, stand pipes, etc. Our experience with one of the best compositions on the market has not been quite satisfactory. It was used during cold weather, and kept at the required temperature in a stream bath. We endeavored to keep the surface clean and dry, but the coating is uneven in thickness.

Mr. Rundlett: This rubber coating is a good coating.

The President: If there is no further discussion we will proceed with the next paper. I think it would be well to wind up with the morning session. The next paper is the report of the special committee on "Electrolysis," F. W. Cappelen, Chairman.

REPORT OF THE SPECIAL COMMITTEE ON ELECTROLYSIS.

Gentlemen: Your Special Committee on Electrolysis has been unable to get together to formulate a report, but begs leave through the Chairman to report progress, as follows:

Electrolysis is a chemical action which may affect metal pipes, especially in clay, damp, salty and gaseous soils, eating off or depositing the material of the pipes, weakening them mechanically and causing leaks.

It is generally supposed and taken for granted that electrolysis is caused only by leakage of electric currents from electric street railway systems. It is, however, a fact, that impurities in pipes or lead cable covers set up "local electrolytic action." In Baltimore, for instance, there was trouble of this kind before electric railways were constructed in that city. Electrolytic action may also occur in gas pipes from local source, as a combination of iron pipe carrying gas, sweating of same in connection with the gas itself, will incur electrolytic action. Such action may also be caused by leakage of urine with a combination ot waste from soda fountains in certain soils on the line of unpaved gutters.

As the main source of the trouble originates with the track work of electric railways, the following methods of prevention have been adopted:

FIRST—

Bonding of rails: (a) by copper wires; (b) by copper plates. (This the better method.)

SECOND—

By running extra copper cables in the danger district for the return current. In Minneapolis on the loops, cables of 1,200,000 circular mills (4¾ inch copper cable about) are used.

THIRD—

By welding the rails.

This last method is the most practicable and excellent results have been obtained thereby.

Mr. Harold P. Brown (member of the committee) will elaborate on his method of prevention in the paper to be read.

FOURTH—

By connecting water pipes at the power houses with proper copper plating to the negative bus bar of the dynamos.

Professor Rowland also makes this point: "At the Station make sure there are not ground plates or ground connections on pipes making a *low* resistance between them and the grounded bus bar" and right in this connection it should be understood that indiscriminate connections of water pipes with the tracks all over the *city* is of no help whatsoever

FIFTH—

By distributing the electric current generators through sub-stations, thereby decreasing the danger limit to a minimum, and last and·

SIXTH—

By using alternating current. Then alternating current will not cause electrolytic action.

This will also be done shortly in Minneapoplis, and then all trouble will be at an end there.

Respectfully submitted,
F. W. CAPPELEN,
Chairman Com. on Electrolysis.

The President: The next paper on the programme is a paper entitled, "The Latest Method of Electrolysis Prevention," by Mr. Brown.

Mr. Sherrerd: That paper was prepared by Mr. Harold P. Brown; as neither he nor Mr. Cappelen are here, I beg leave to present the paper for Mr. Brown.

The President: Will you read the paper?

THE LATEST METHOD OF ELECTROLYSIS PREVENTION.

HAROLD P. BROWN, ELECTRICAL ENGINEER.

During the past two years the writer has had extensive dealings with European and Australian electric tramways and has thus become somewhat familiar with foreign methods of guarding against electrolysis.

Municipal authorities in Europe are not content to wait until the underground pipes have been damaged before giving the matter official attention. On the contrary, eminent electrical engineers were long ago consulted as to the cause of the trouble and, with their guidance, stringent rules were adopted with which the tramway companies must comply.

Early in the history of electric lighting the same course was followed, but in that case the Regulations of the English Board of Trade were so severe that for years corporations could not profitably operate in accordance therewith. In consequence the business was practically stagnant until experience in this country had shown that the restrictions could be relaxed without danger. The Regulations of the same Board concerning the operation of electric tramways are, from the American point of view, needlessly severe, and few, if any, of our electric roads could operate under them with present equipment.

On the other hand, the English authorities must regard with amazement the neglect of many of our cities to protect their own underground property. Between these two extremes is a golden mean which, in the opinion of the writer, this association should carefully determine by a Committee of Experts who have had practical experience in the matter. The English rules act in two ways to check electrolysis: they permit but a small percentage of the railway current to return through the earth and they limit the difference in electrical pressure which may exist in the rail return circuit. The rules do not lay down methods to be followed in getting the desired results, but their narrow limits force the tramways to maintain a perfect rail return and to employ the most expensive systems of electrical distribution in order to cover large areas. Registering instruments are used to detect any failure to obey the rules and the responsible officials or employés are fined and the current may be cut off if the fault is not corrected within twenty-four hours. In this country things are managed differently. For the benefit of those not familiar with the subject, a brief explanation of the cause of electrolysis may not be out of place. When an electric current passes from one metal plate to another through a conducting chemical compound like water, the fluid is decomposed: its oxygen appears at the positive plate from which the current flows, and its hydrogen at the negative plate. If the positive plate will oxidize, it is corroded by the oxygen. Of the metals ordinarily used for pipes, lead will corrode more rapidly than wrought iron, and the latter more rapidly than cast iron. Lead service pipes and lead joints in water and gas mains are therefore the first to show injury from electrolysis. It is well understood that the current to operate the electric cars is carried from the dynamos to the trolley wires and after doing its work in the motors, passes through the car wheels to the rails. The current then follows the pipes, doing injury at every defective joint, until within a short distance from the power house, when it again passes through the earth to the rails and thence through wires to the dynamos. The course of the current is shown in figure 1. The greatest damage is done to the pipes at the point where the current leaves them and these points can

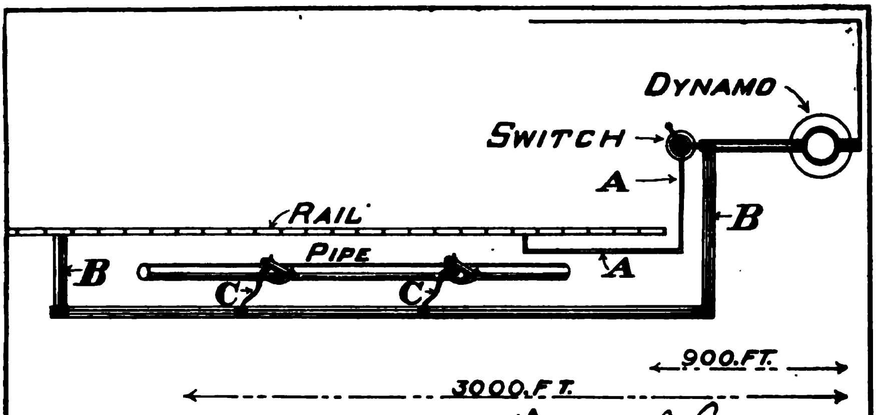


FIGURE. 2. Harold P. Brown.

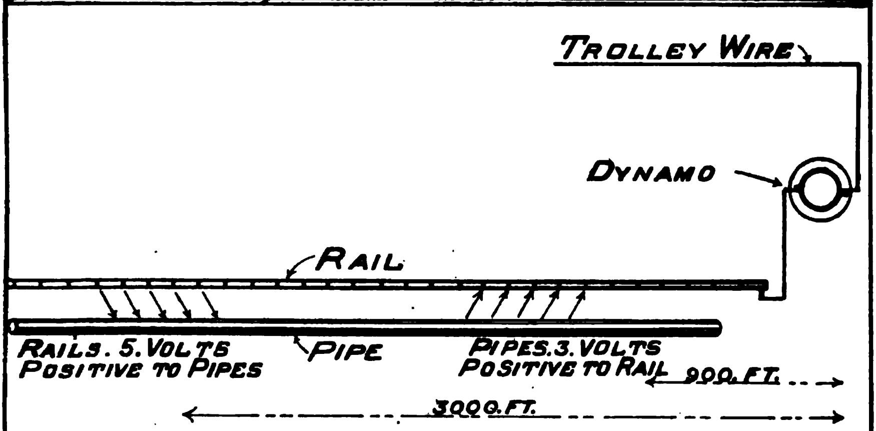

TROLLEY WIRE
DYNAMO
RAIL
RAILS. 5. VOLTS POSITIVE TO PIPES
PIPE
PIPES. 3. VOLTS POSITIVE TO RAIL
900. FT.
3000. FT.

FIGURE. 1

be determined by electrical measurements on the surface of the street. The most accurate method of making such measurements was fully described in a paper by the writer read before this association at its Cincinnati meeting. The rate of corrosion is in direct proportion to the difference of electrical pressure between the pipes and the rails. The entire trouble is caused by the fact that the path for the current through the rails is a poor one and grows poorer every day. If the rails were absolutely continuous lines of metal, the rate of electrolytic corrosion would be slow. But every thirty feet the rails end and the circuit is broken, since the oxide of iron on the rails and joint plates is practically an insulation. Attempts have been made to obtain continuous rails by electric welding, but this process, on account of the necessary flux, not only fails to make an electric joint of low resistance but also decarbonizes and softens the metal to which the high heat has been applied, thus producing in a short time two low spots at every joint. Great conductivity has been claimed for what is called the "cast-weld" joint. This consists in pouring melted iron into a metal mould placed around the rail ends, which is supposed to form a weld of low resistance. Though this is an excellent mechanical joint, it is not a conductor as is proved by the recent discovery in Chicago of badly corroded gas and water pipes under a double track of very heavy rails which, it is stated, had "cast-weld" joints and was also provided with two large copper bonds at each joint. There are very many types of copper bonds for making an electric contact between rails, ranging from old bits of wire roughly riveted into holes in rails, up to flexible strips of copper bands or cables with elaborate clamps or contact devices. But there are three forces always at work to destroy a copper bond: first, heat, since the different ratios of expansion of steel and copper will spoil the contact surfaces; second, the pounding of the car wheels at a joint, which makes the copper brittle; and third, chemical action of the moisture in the earth on the two metals. This tends to dissolve the copper and to coat the steel heavily with iron oxide. So powerful is this action in certain soils that even tin-plated copper wires one-half inch in diameter, buried between the rails, have been so damaged within three years, that only slight traces of them could be found. Many of our American street railways are built by contractors who have no interest in the economical operation of the road nor in the damage that their poor or cheap work may inflict on city water pipes. Their sole business is to do the construction work as cheaply and as quickly as possible and to get their money.

This class has created a demand during the past two years, for a fifteen cent copper bond, when safety of pipes and economy of operation require eight or ten times that amount of copper. So some of our municipal authorities are thus idly permitting a practice which, in time, will produce leaky gas and water pipes as at Spokane, Washington, in September, and may even cause gas explosions similar to the one in Boston a few months ago. At the very best the results of this work will mean an eventual tearing up of city pavements in certain localities to patch or replace the pipes. Now this can be to a great extent prevented by passing an ordinance requiring that the conductivity of the rail joints in any electric road shall be sufficient to carry the maximum current required and by providing for the regular inspection of the joints. One inspector, who need not be an expensive man, if provided with an instrument similar to that shown in accompanying photograph, could easily do effective work for 50 to 75 miles of double track. Maps of each line of road should be made on a scale not less than 50 feet to the inch and a careful record kept of the electrical condition of each rail joint so that each imperfect bond could at once be replaced. This instrument, which was built by the Weston Company from the writer's designs, enables one man to obtain an accurate reading of the amount of current passing through the rail and to determine the exact electrical loss at the joint, and, therefore, locate the trouble from electrolysis of the pipes. The same instrument can be adapted for measuring the electrical current flowing through gas and water pipes without cutting them, and is the first successful apparatus ever made for this purpose. The first one is to be used in the city of Newark, N. J., by the Consolidated Traction Company, and each division of this large road will soon be provided with a similar one. In addition, it is proposed to run pilot wires from the water pipes in various portions of the city to electrical instruments located in the headquarters of the Fire Department where an operator is constantly on duty, so that, if any dangerous electrical condition of the pipes is indicated, attention will at once be called to it.

Similar instruments are placed on the switch-board at the railway power house, so that two independent observers will be always on the watch for trouble. After thus detecting and locating the trouble, the next step is to remedy it. This has been done at Newark under the writer's direction for the past two years, by connecting separate insulated wires from the points on the pipes that were formerly positive, to a separate dynamo at the nearest power house. The pressure on this dynamo was maintained at a higher point than the dynamos connected to the rails. The attendant by varying this pressure can obtain the desired result and absolutely control the electrical condition of the pipes. It must be remembered that the pipes are not injured by electrolysis as long as they are negative to the rails. After testing this method for the past two and a half years, the railway company has made an appropriation sufficient to install an improved method of electrolysis prevention designed by the writer, which, although much more expensive than the one just described, will not require the independent dynamo and will not need adjustment as the load upon the dynamo varies. The method has the additional merit of reducing the flow of current upon the pipes to the minimum. An ample return circuit is connected to the lines of rails nearest to the power house, which is marked AA on accompanying diagram, figure 2.

The return conductor BB is insulated and has a carrying capacity four or five times greater than AA. It is connected to more distant points on the road where formerly current passed from the rails to the pipes.

In Newark these conductors are respectively about 900 and 2,800 feet long. Each is connected to the negative pole of the dynamos. Insulated wires CC are then connected between the points on the pipes which were formerly positive and the conductor BB. With this arrangement an adjustment is made at time of heaviest load so that the distant end of BB is 4 to 6 volts negative to the distant end of AA. This adjustment is effected by turning a switch S at the power house so as to vary the resistance of conductor A. When this is done, the resistance of the wires CC are set so that each pipe connection is about one volt negative to the nearest rail. This adjustment is made in the conduit manhole where wire C joins B.

By these connections the pipes are held permanently in a safe electrical condition and the current flowing on the pipes is reduced to its minimum. Since this plan requires BB to have great conductivity and since the proper amount of copper would cost at Newark $30,000 for the bare wire, the company is utilizing as electrical conductors old tram rails, that are worth about $10.00 per ton as scrap steel.

These are placed in a box of creosoted wood which rests on the cemented top of a terra cotta conduit for the feed wires. Every 15 feet the rails are clamped together by heavy plates and bolts.

Electrical contacts between the rails and plates are made every 15 feet by means of Mr. Edison's Plastic Bond, whose material will not corrode nor break nor lose conductivity as time passes. The box is then filled with a liquid insulating compound to preserve the steel.

Two conduits of similar rails connected in this way have been in use at Newark for nearly three years without depreciating. The electrical resistance is practically the same as though it were a continuous piece of steel. The new conductor is composed of 16 parallel lengths of rail, weighing 50 pounds to the yard, and it is equal in conductivity to a copper rod having a section of 18 square inches.

Its total cost is about one-sixth that of the copper, or $5,000. With this system in use and with the careful detection of badly bonded joints, electrolytic corrosion of Newark's pipes will be a thing of the past. It is the present practice of railwaymen to make light of electrolysis, but it is a difficult problem at best and each place presents new complications. In many cities where there are several systems of pipes, it is necessary to protect against current flow from one set of pipes to another and this flow may occur at any part of the city. Cases have been observed where the electrical pressure between gas and water pipes in a house was sufficient to operate call bells or to even cause fire. This calls for permanent contacts every few blocks between the mains, and each house owner should connect together in the same way his service pipes at a point just inside the wall. Electrolysis prevention is a difficult problem at best and cannot be secured, as so many railway men claim, by merely running copper wire from a water pipe to the dynamos. I cannot close without again urging the appointment of a proper committee on this subject, to submit to the next convention a Code of Regulations which shall safeguard the interests of the various cities without imposing any unfair conditions upon the railways.

Mr. Rosewater: I do not want to indulge in any long discussion on the subject, but I had occasion, a little over a year ago, to make an investigation of electrolysis in various cities of the United States by correspondence, and to make a special investigation of the city of Omaha with a view of determining the nature and the extent of the damages that occurred in a suit brought by the Water Works Co. against the Street Railroad Co., and I was surprised at the result of the investigation, both locally and outside of the city. I investigated and secured replies from as may as fifty cities in the United States as to the actually known condition, the character of the soil, the character and size of the pipe, etc., and from these investigations I have arrived at a set of general conclusions.

First, that the damage to water pipes and water works systems through electrolysis is much smaller than is usually supposed; secondly, that it is confined largely to an area of perhaps one thousand feet from the power house; third, that in view of power houses being, as a rule, outside the central districts, where the water pipes are not large, the damage is on small pipes and not on large. In all of the answers I have secured I have not found a single instance of a pipe larger than sixteen (16) inches that was materially affected by electrolysis. The remedies are few. I will say that the investigation made in the city of Omaha happened in this way: About the time this suit was brought, the city had attempted to enforce a judgment on the water works because of a contract they had with the Water Works Co. to furnish the fire service, and this fire service was actually impossible, in view of the increased draught on the water works system since the original extension of the work, and as a result the Water Works Co. ultimately agreed to enlarge the system within a quarter of a mile of the city, according to plans furnished by the city, so we had to take up all the pipes within nearly a quarter of a mile of the city, and, to my surprise, and the surprise of the Water Works Co., we found no material effects upon the pipes, although the system of electric cars had been in operation for nine years, except within a radius of perhaps one thousand feet from the power house. The greatest damage that I discovered was by an investigation by the plumbers throughout the city. I sent out a lot of circular letters to all the plumbers to ascertain whether any appearance or signs of electrolysis had been discovered on the service pipes, and I found that the service pipes, within a radius of one thousand feet of the power house, had been in some cases destroyed in less than three months from the time they were laid, but we discovered a remedy which consisted in laying the service pipes inside of drain pipes and putting them down, and in that way protecting the pipe against the action of electrolysis. As has been illustrated here (referring to a diagram on blackboard), electrolysis, when it takes place, is on each side of the pipe where the current leaves the pipe on endeavoring to reach the power house. Since the service pipes run at right angles to the line of the street, they are invariably attacked across the entire line, and the current, as you will find by an examination of the pipes along the entire line of the pipes between the houses, the line of the water works pipes and the main pipes are only affected at a point nearest to the power house, where the current leaves, hence it is very apparent that the effect upon the large pipes in the city cannot be so great in the central part of the city, because of the large amount of conductive substance or pipe system, until it reaches a point where the pipes begin to be smaller. These power houses being in the outside districts of the city, the pipes in the vicinity of the power house are more affected—at this point the current affects them, but it only affects the smaller class of pipes. It does not affect the large pipes, although it may affect the small water pipes, because that is possible.

There are several methods, or plans, for the prevention of electrolysis that have been adopted very successfully. One is to carry a conductor, an insulated conductor, along the line of the railroad tracks, and connecting it at intervals of five hundred feet to the track, and so arranged that it will carry the return current to the power house. Then there is a system of protection by connections, within the danger radius of the power house, with the water mains. It is sometimes advisable, in a question involving the application of various remedies, that it ultimately be resolved into a question of dollars and cents, whether or not a system that would cover an entire city, especially one that would cost a large amount of money, would be better than to renew the small pipes within a certain radius of the power house at given intervals. As to the others, I would say, of course, that as to small service pipes the remedy is easily applied. I presume there would be various methods that could be used, outside of using the simplest, cheap method as the plumbers discovered of surrounding the pipes with drain pipe, getting it imbedded in heated asphalt and beating it down, it would cost very little.

MR. STAINSBY: Why should the city pay for that?

MR. ROSEWATER: I did not say it should; I say there was a certain condition existing in the city of Omaha. The street railroad was one corporation and the water works was another, and the city is not the owner of either, and therefore comes the conflicting interest between the city and the water works in regard to services, etc., whereas, if it only involved the two companies, they could settle that question between themselves, or unless where the city is the owner of the water works plant and not of the street railway, then of course it is their duty to take care of themselves by requiring the railway company to pay the city damages, and I think it is their duty to do that, but I say that has not been the condition. If the city owns the street railway they can determine whether the damage to the local water pipes is within a certain distance of the power house and ascertain their damages.

Mr. Benzenberg: I didn't hear the entire reading of the paper, but it seems to me the very best remedy there is for it is the one used by Cincinnati, in having a double overhead trolley wire by which the current is not allowed to enter the ground at all, but is returned by a second connection to the return cable, leading the entire current back with as little loss of voltage as possible to the power house. I think if the railroad companies fully understood the economy there is in that sort of an arangement they all would apply it, for I am satisfied there could be no greater economy to them. It just means a saving of so much coal. Where there is no overhead trolley return cable, some of the current is going into the ground and some of it is going to lodge into the water pipes, the remedy for which is so apparent that it should be universally applied. If you already have the current upon the pipe, it is the duty of every water works official to protest against carrying any of the current along the pipes and allowing it to escape, where the lines are so constructed as to give it a chance to escape. The remedy is to make a connection from your pipe line to the negative pole of the generator. If you make a conductor of the pipe line, there is no chance for any trouble provided the conductor is made ample all the way along the line, without any opportunity for the current to escape except by this connection.

The President: Mr. Brown recommends that this committee be continued for another year. What is the pleasure of the convention?

Mr. O'Brien: I move that the committee be continued for another year, and that the President is authorized to appoint the same.

Motion seconded and prevailed.

THE PRESIDENT: The next paper is "School Inspection as a Means of Preventing Contagious Diseases," by Dr. J. M. Witherow. Dr. Witherow is not with us, but Dr. Reynolds will present the paper—he will read it to the Society.

SCHOOL INSPECTION AS A MEANS OF PREVENTING THE SPREAD OF CONTAGIOUS DISEASES.

J. M. WITHEROW, M. D., HEALTH OFFICER, CINCINNATI.

I have recently investigated the records of the Health Department of Cincinnati, comprising the number of cases of the acute, infectious diseases, measles and diphtheria, with a view to ascertaining the time of year when such maladies were most prevalent. The following tables, which I will not tax your patience to read, other than to summarize, will indicate the result of the investigation. Total number of cases and deaths from measles and diphtheria for the years 1894, 1895 and 1896:

	Measles		Diphtheria	
	Cases.	Deaths.	Cases.	Deaths.
January	519	18	169	40
February	726	20	134	37
March	632	21	124	38
April	795	33	136	37
May	1,011	26	108	29
June	759	31	121	22
July	271	11	101	26
August	50	3	117	25
September	18	3	165	41
October	27		292	53
November	110	2	258	57
December	348	18	226	62
Total	5,266	186	1,951	467
Average per school month	504.5	17.2	173.3	40.6
Average per vacation month	160.5	7.	109.	25.5

It will readily be noticed that the months of greatest prevalence are the months when the schools of the city are in session. The increase of the total number of these cases during such months, over the months when schools are taking the vacations, rather clearly indicates that the schools are centers of dissemination. The importance of the matter may be briefly summarized in the following statement:

Taking the number of cases occurring per month, during July and August, when the schools are in vacation, as the normal number of unpreventable cases, we find from the above tables that 100 deaths from measles and 150 deaths from diphtheria have occurred as a result of public school infection during the last three three years, and that 1,400 cases of measles and 650 cases of diphtheria have had a similar origin.

It would, therefore, seem that Health Departments, with the advice and assistance of the medical profession, should take every possible step to lessen this great death-loss from the infection of pupils attending public schools.

From experience elsewhere it has occurred to me that it would be wise for some system of inspection to be adopted with a view to preventing as far as possible this source of infection.

Boards of Health should take this matter in hand, and appoint a corps of inspectors who should be physicians of unquestioned ability.

Each school inspector should be assigned to such schools as he could easily inspect in the first hour of the morning school session each day.

The teachers in the various schools should, immediately after roll-call, each morning, inspect the pupils under their charge with a view to ascertaining their condition of health.

All children not appearing to be perfectly well should be sent from the school-room to a suitable room in the school building, where the physician, acting as inspector, could carefully examine them, with reference to their being possible subjects of contagious diseases, or being infected with vermin.

All suspects should be immediately sent home with a card from the inspector to the parents, asking that medical attention be immediately called to the treatment of the case.

Other children living in the same family should at once be sent from any school that they may be attending, and none of these be permitted to re-enter the school without a satisfactory physician's certificate stating that they had recovered from any infectious illness. In cases of sore throat the inspector should make cultures from the inspected throat and send them to the department laboratory for investigation.

In any case where the bacteriological investigation shows the presence of the Klebs-Loeffler bacillus, which is the specific germ of infection in cases of diphtheria, the patient should be kept from school until an authorized examination, by the Health Department, shows that the throat is free from any of these germs.

It is well known that the germ remains in the throat for a considerable period after the disease has apparently recovered and the patient has become personally immune to the effects of the germs, and yet is capable of producing the disease in others so long as these germs remain in the throat.

The school authorities should, therefore, not permit any of such children to return to school until the proper authority in the Health Department, after a bacteriological investigation, pronounces them free from the possibility of producing disease in others. The School Inspector should not attempt any treatment or in any case prescribe for the pupils thus sent from the schools, but require the parents to secure the necessary attendance.

The Inspector should, at the same time that any child is thus isolated, inform the Health Department, and a sanitary officer should be sent to the residence of such pupils to look into their sanitary surroundings and to ascertain what pupils in the immediate family or tenements are attending other schools, and see that they are detained from school attendance until the danger of infection has passed.

The Health Department should also inform the principals of any other school that might be affected by such cases to see that the order of the Health Department was obeyed, so far as permitting the attendance of those quarantined by the order of the Department. In connection with this proposition to secure suitable inspection of pupils themselves, it would seem wise to follow out some sort of disinfection for school buildings, including the disinfection of school rooms, desks, books, in all public schools. This ought especially to be done where a case of infectious disease is discovered by the Inspector in attendance upon the school.

It would seem wise, upon general principles, that where large school buildings are used by great numbers of children that a weekly disinfection of the building should be performed.

The floors, doors, door-knobs, stairs and hand-banisters should be washed with a washing-soda solution, say ½ pound of washing soda to 3 gallons of water, at least once a week. Desks should be treated in the same manner.

Desks that have been occupied by pupils sent out by the Inspectors should be treated with the same solution.

This communication may be pardoned a little digression to call attention to the use of slates in public schools. The use of the slate is a filthy practice in itself, and is often the means of bringing the saliva of one mouth indirectly in contact with that of another.

In addition to this, many educators are objecting to the slate because it induces the practice of holding the pencil with so firm a grasp as to give the hand writing a cramped appearance, and for the further reason that in actual life the slate is never used except, possibly, by the boss of the political machine.

The great difficulty which confronts us in the immediate adoption of this plan of inspection in Cincinnati is its expense. Appropriations have been made for the ensuing year, but only sufficient to cover the actual expense of the Department, as existing at present, with no provision for school inspection.

I have not yet been able to ascertain definitely the expense of such inspection, but have thought that School Inspectors of competence might be secured for, say, $20.00 per month, as inspection would require them to make one visit each day for the 20 days of the school month.

In many instances it would require an inspector for each building because few of the buildings are situated so closely together as to make it possible for one inspector to attend more than one school. Of course, it will readily be seen that, in a few instances, two or three schools are so closely together and the number of children to be examined each morning would probably be small, so that such buildings may be included in the work of one inspector.

The proposition to secure a medical inspection of schools is not original as the plan has been put in practice in New York since March, 1897. As an evidence of its usefulness the exhaustive and satisfactory report of Dr. Roberts of the New York Board of Health shows that since the plan has been in operation in that city, during the period of four months, 4,183 out of a total of 63,812 children examined, were excluded from the school on account of an infectious disease.

When we realize that in Cincinnati 2,050 cases of measles and diphtheria, and 250 deaths from the same causes, have been largely produced by a lack of proper inspection, we must conclude that the demand is so great that the cost is not to be considered.

DR. REYNOLDS, CHICAGO, ILL.: With reference to the paper of Dr. Withrow that I have just read, perhaps I may be permitted to add that, while it is true that contagious diseases generally present a lower mortality and a lower prevalence during the summer months than during the winter months of the year, the same is also true of pneumonia, consumption, bronchitis and other diseases as well. The reason is not far to seek, because sunlight and fresh air are better secured in summer than in winter, and they destroy the germs of the diseases. Fresh air and sunlight are Nature's great disinfectants, and in summer the children are out of doors and the houses are better ventilated.

With reference to priority in school inspection work, the essayist seems to have the idea that this is entirely new except in New York. The fact is, New York is quite behind the times in reference to the inspection of schools. School inspection is indeed quite old with reference to vaccination and the prevention of scarlet fever. Boston was the pioneer in general sanitary school inspection, beginning in 1895. Chicago began this work in 1896.

I have here our monthly report for July, showing one year's accomplishment in this work, from July, 1896, to June, 1897, in Chicago, and if I be permitted I would like to read a paragraph:

"In this year in Chicago a total of 1,181 visits were made to the schools during the school year; 4,023 cases of contagious and infective diseases were located and taken charge of for preventive purposes; insanitary conditions in sixty-three public schools were reported to the Board of Education, and similar conditions were remedied in fifty-three homes of patients. An important feature of the work was the examination as to vaccinal status of the pupils of schools visited; 914 such school examinations were made, covering a total of 109,220 scholars—81,810 in public, and 27,410 in parochial schools. Through these examinations 47,310 vaccinations or revaccinations were secured—37,470 of public scholars, and 9,840 of parochial scholars. Of the diseases reported, diphtheria was the most prevalent—744 individual reports of cases among school children leading to the disclosure of 2,619 cases at homes. There were 231 school cases of scarlet fever and 745 home cases. Forty-six reported cases of measles led to the discovery of an epidemic prevalence of the diseases in several sections of the city during November, 1896, and again in May and June, 1897. In October an epidemic of impetigo contagiosa spread through seven schools of the North division of the city, but was arrested in a few weeks, after excluding 107 cases from the schools and instituting proper preventative measures. Two schools were found afflicted with pediculosis to such an extent as to demand radical treatment. One case of tuberculosis was found at school in such an advanced stage as to justify exclusion from school attendance; this patient died before the close of the school year. Stomatitis was found so prevalent in many schools that, upon the advice of the Medical Inspectors, the teachers instructed the pupils to bring individual drinking cups from their homes and forbade the common practice of putting the lips directly to the water faucets for drinking. The commonest sanitary defects of the school buildings reported are uncleanliness; dirty floors;

passages and stairways; damp and filthy basements; foul water closets located near furnaces, so that poisoned air is driven through the building —in which cases teachers suffer from headache, 'sore throat,' etc. Among other insanitary conditions noted are defective plumbing, stagnant pools on adjoining lots, dirty alleys, overflowing garbage boxes and general lack of sanitary policing. In few of the older school buildings is there any provision for drying the feet and clothing in wet and stormy weather."

I might add that in Chicago all cases of contagious diseases are not reported to the Department of Health. The location of such cases as are reported is immediately sent to the Superintendent of Schools, Board of Education, to the Public Libraries, and other places where the public congregate and where contagion might spread.

THE PRESIDENT: The last paper on the programme is "Bicycle Paths," by Mr. Rundlett.

BICYCLE PATHS.

BY L. W. RUNDLETT, CITY ENGINEER, ST. PAUL, MINN.

The bicycle in its early history was regarded merely as a mechanical toy and its development was slow. Even ten years ago it did not particularly command public attention, and its utility for the public benefit was not thought of, but with the development of the "safety," with a chain-driven wheel, diamond frame, and pneumatic tire, the possibilities of the wheel began to be understood and appreciated by the world. The growth of wheeling was then phenomenal and the bicycle craze, as it was called, swept over the land and took possession of the old and young, rich and poor, men, women and children alike. Its popularity was definitely established and even those who looked with disfavor upon the invention were obliged to admit that the wheel had come to stay.

The manufacture of bicycles has become an industry of the greatest magnitude, and it is even claimed that it is the largest specific manufacturing industry in the country to-day. It is estimated that for the past two years nearly a million wheels have been annually manufactured in America, and over one hundred million dollars have been annually expended by the public directly or indirectly on wheeling. In every civilized land the bicycle has become a familiar object and it has even penetrated to the remote corners of the globe.

The use of the bicycle is now extended to almost every profession and occupation in life. Professional men in general and an army of clerks go to and from their houses and places of business, and the artisan to his work, on bicycles, while to women and children it is a source of enjoyment combined with healthy exercise.

The telegraph messenger boy no longer loiters on the corner to gaze in the attractive window or stops to play with boon companions, but mounted on his wheel, with an eye on the police, he feels the inspiration of a man on horseback and scorches with all energy to the performance of his once burdensome, but now attractive duty. The commercial traveler visiting his country customers, utilizes his wheel in going from town to town. Police on wheels now, to a considerable extent, take the place of the mounted police, particularly in park service. Trials have been made of wheels for army service and it has been found that small detachments of troops can make more rapid progress on their wheels than mounted cavalry.

Provisions for the care of bicycles are now made in all large office buildings, manufacturing buildings, wholesale houses, and stores, where a large number of men and women are employed, and it is considered as essential to provide a place for the wheel as for articles of apparel.

Legal action was necessary before the bicycle was accorded the ordinary privileges of the road, and it was not until June, 1887, that the Liberty Bill passed the Legislature of New York and gave to the wheelmen the right to pass through Central Park, the boulevards and every public thoroughfare of the metropolis. The necessity of concerted action to secure the rights of wheelmen probably led to the formation of the League of American Wheelmen, in October, 1880, which has become a great national organization with headquarters at Boston, and branches and representatives in every city and territory of the Union, and has enrolled at the present time one hundred thousand members, the number having nearly doubled within a year. The principal object of the organization was to obtain good road construction and to secure better and more intelligent expenditures of the appropriations by States and counties for this purpose. Through their efforts the attention of the whole country has been called to the enormous yearly expenditure in the transportation of the crops to market on account of the improper construction and maintenance of country roads, and good roads conventions have been called in almost every State in the Union, which have resulted in much good. In some States, as Massachusetts, New Jersey and Connecticut, the expenditure of the appropriations for public roads is now placed under intelligent supervision and subject to the inspection of a practical engineer. In Minnesota a bill was introduced in the last legislature to form a State Road Commission which would have control of the State road appropriation and render intelligent assistance to the county and township work, but the bill was defeated by the representatives of the country districts, the very people whose interests would have been greatly advanced by the proposed bill. They preferred, rather, to work out the road tax under the old way and endure the ills coincident to ill-advised and poorly constructed roads, still a start has been made and if the agitation is kept up results will follow.

With the great multitude of men and women using the wheel both for business and pleasure, there can be no doubt of their right to the occupancy of some portion of the streets and public thoroughfares, and provisions must be made in the ordinances covering traffic of the street to put them on an equal footing with the pedestrians or the vehicles that travel the roadway. It took some time for our city fathers of St. Paul to recognize this fact. Bicycles at first were considered a nuisance on the street and sidewalk, but as the number increased and the public became accustomed to them, this sentiment gradually wore away. Moreover, the number of wheelmen has so increased that they represent quite a power at the polls, and without giving allegiance to any particular party they could easily be able in any local election, to elect to office those who would at least show them justice in establishing rules and regulations for the proper use of the streets and sidewalks. The greatest enemy to the cyclist in moulding public opinion, is the scorcher, whose sins are visited on all wheelmen, and they are held responsible for his misdemeanors, but their numbers are very few, and if their action is vigorously condemned by wheelmen, with the assistance of the police they can easily be repressed and made to confine their desire for fast riding to the race track or other proper place where they can not injure or annoy either the wheelmen or pedestrians.

It being, then, considered that the bicycle is now universally recognized as a proper vehicle for travel, and entitled to the use of the public streets under reasonable restrictions, the question arises as to what portion of the street wheelmen shall use and whether any special provisions of construction shall be made in any of the streets for their accommodation.

On streets in the business districts of the city, also on all paved, macadamized or well graveled streets in the residential districts there can be no doubt but that the use of the bicycle should be confined to the roadway. On residential streets that are not thoroughfares, where the pedestrian travel is light and the streets are not surfaced with a material which is suitable for bicycle travel, the use of the sidewalk should be permitted with reasonable rules regulating the speed of the rider, and requiring the use of proper precautions in meeting or passing pedestrians.

There are also main avenues of travel to parks, ball grounds, summer resorts, and into the country, where neither the roadways or sidewalks afford proper facilities for the wheelmen, and where the travel for both business and pleasure demand the construction of a special roadway or bicycle path to properly accommodate the traffic, and it is the object of this paper to give a brief description of the work done on bicycle paths of this nature in St. Paul during the past two years, showing how the money was raised and expended, and the methods of construction used, hoping in this way to bring the subject properly before the Society for discussion, and to gather valuable information as to the general practice in other cities.

The situation in St. Paul is perhaps somewhat different from most cities. There is included within the city limits an area of a little more than 55 square miles. There are about 45 miles of paved streets, 10 miles of limestone macadam, and 375 miles of graded streets where the material used is simply the best that could be found on the streets. The cost of this grading was assessed on the abutting property and at the time the improvement was made no better construction was warranted. The material of which the roadbed has to be constructed is generally a clay loam, black loam, sand, or red clay, somewhat of the nature of hard pan. Very little bank gravel can be obtained and, as a rule, requiring too long a haul to be made available.

While with care this material makes a fairly good road-bed under favorable conditions, these streets are not suitable for bicycle travel in wet weather, and are very difficult to keep in good repair, being easily cut up by heavy traffic, and becoming dusty in dry and muddy in wet weather.

The wheelmen of St. Paul are quite strong numerically, it being estimated that there are about 15,000 wheels in use in the city. They are also quite strong in having a number of active and enthusiastic wheelmen who are willing to spend time and use influence in the aid of bicycling interests.

Realizing the necessity of having better facilities for wheeling on the principal lines of travel, a meeting of wheelmen was called in the spring of 1896, and a local organization formed under the name of the St. Paul Cycle Path Association, and after some discussion it was determined to raise a fund by subscription from wheelmen to start the construction of bicycle paths. A fund was accordingly raised, mostly from $1 subscriptions. Authority was obtained from the Common Council to construct a path on Summit Avenue boulevard, and the work of construction was placed under the direction of the Engineering Department. Summit Avenue boulevard has a width of 200 feet, with driveways on portions of the street in the center, and on other portions, on the sides. Where the grass plot was in the center a ten foot bicycle path was constructed, and where the driveway was in the center two six foot paths were constructed, one on each side.

The success of this path was so pronounced that it was then determined to construct a path to White Bear Lake, a popular summer resort. This new undertaking required the construction of about 10½ miles of cycle path. An appropriation of $500 was obtained from the Common Council to construct the path inside the city limits, $1,000 was appropriated by the County Commissioners to assist construction in the County, and the balance was raised by subscription. This path was built three feet wide at a cost of about $2,500. Within the city it was built on the sidewalk space about two feet from the property line (there being no regularly constructed sidewalk).

In the country it was built alongside of the county road, and more or less grading was required. The width in the county has since been increased to six feet to allow wheelmen to meet and pass without danger of accident, it not being generally practicable to turn off the path without danger.

The total amount expended on cycle paths during the year 1896 was $3,500, of which the city contributed $700, the county $1,000, and the balance, $1,860, was raised by subscription.

During the present year the cycle path work has been continued and about 12 miles of new paths have been built, all but about 1¾ miles being within the city limits.

These paths have been constructed along lines of travel where the wheel traffic demanded something better than the ordinary dirt road to places of resort, like Como Park, Athletic Park, Fort Snelling, Town and Country Club, and our neighboring city of Minneapolis.

On this year's work there has been contributed and expended on construction or repapirs, the following:

By subscription	$2,000
County appropriation	905
City appropriation by Common Council	950
	$3,855

Other work has been authorized by the Common Council, but owing to a shortage in the street fund, will have to go over until another season.

METHOD OF CONSTRUCTION.

The bed of the cycle path was first brought to sub-grade and rolled when necessary. Wherever obtainable, gravel, free from stones and large pebbles, was then put on in sufficient quantities to bring the path to proper grade, and rolled while damp until the gravel was thoroughly packed so that a wheel made no impression.

Our experience shows that gravel makes the most desirable path. In places where gravel could not be obtained and cheap construction was necessary, a mixture of sand and loamy clay in sufficient quantities to bind the sand, was used, but was not as good to shed the rain, and was more easily cut up by stray cows or horses.

The usual construction was first to put a bed of soft coal cinders, or, when they could not be obtained, a bed of hard coal ashes, on the sub-grade, and thoroughly roll and cover with about ½-inch of loamy clay, and a coating of coarse, sharp sand. The clay and the sand were moistened and rolled until thoroughly consolidated. Fine gravel on the cinders made a still better construction but could not generally be obtained. At street crossings broken stone was used for a foundation and screenings or gravel for surfacing.

The depth of the material and cross-section was in accordance with the width of the path.

A ten foot path was given a crown of about 4 inches, the depth of cinders about 4 inches in center and two inches on the edge.

A six foot path, 3-inch crown, depth of cinders 3 inches in center and two inches on side.

A three foot path, two to three inches of cinders, slightly crowning.

All are covered with about ½-inch of covering of sand and clay as described above.

The quantities of material actually used in the construction of these paths was as follows:

10 foot boulevard path, cinders 400 cu. yds. per mile.

8 foot path along graded street, 200 cu. yds. per mile.

6 foot path along street and county road, 130 cu. yds. per mile.

The sand and clay generally have been found near the work and no account has been kept of the actual quantity required.

The cost of construction has been as follows:

Ten foot cinder path where sod had to be removed but no other grading done, built in substantial manner as described above, with broken stone street crossings, labor 18¾ cents per hour, and teams 37½ cents an hour, cinders 40 cents per cubic yard delivered on the ground, $500 per mile.

Eight foot cinder path along graded streets, labor 15 cents per hour, teams 30 cents per hour, cinders 25 cents per cubic yard delivered, $250 per mile.

Six foot cinder path along side of county road where path had to be graded and cinders hauled 1½ miles, $200 per mile.

Cost of six foot gravel path along graded street, material hauled an average of 1½ miles, $100 per mile.

Cost of three foot cinder path along graded road, $165 per mile.

The figures here given would vary considerably in accordance with the facility with which the material could be obtained. They represent the average cost of the paths as constructed.

These paths on graded streets were placed, whenever there was no sidewalk, in the sidewalk space near the property line. Wherever a sidewalk had been constructed the path was generally placed next to the sidewalk and occasionally next to the roadway, leaving a space for trees and grass between the path and sidewalk.

All the paths built in the city have been constructed under the direction and supervision of the Engineering Department. The work has given general satisfaction and has been very favorably commented on by wheelmen from other cities.

The figures submitted show at what a comparatively trifling cost the interests of a considerable portion of the population can be cared for. An ordinary six foot plank walk for the use of pedestrians costs in St. Paul from 25 to 28 cents per running foot.

A six foot cycle path can be constructed at a cost of from 4 to 5 cents per foot.

As an illustration of the number of people using the paths, count made at different time shows on the cycle path leading to Como Park, about 2,000 per day; on the Summit Avenue path, 3,000 per day, and on cycle paths leading to White Bear and other resorts, from 450 to 900 per day.

When the cycle path to White Bear was first proposed it met with considerable opposition from the farmers and gardeners along the route, but since it has been built the sentiment has changed and it is now regarded as a great improvement, the city practically furnishing them a sidewalk which is specially used by their children going to or from school, either on foot or wheels.

As a general rule no particular difficulty is experienced in locating a cycle path on any street where the necessity of such a path exists; 60 feet is, with but few exceptions, the minimum width of streets in St. Paul. From 24 to 30 feet is ample for a roadway, six feet on each side for a sidewalk is sufficient, leaving from 9 to 12 feet on each side for cycle path, trees, etc. On streets from 80 to 100 feet the problem is much easier. Como Avenue boulevard, the principal approach to Como Park, is 100 feet wide and is laid out as follows: Roadway, 38 feet, two sidewalks, 6 feet; two cycle paths, 7 feet wide, each running in the center of a grass plot between the roadway and the sidewalk.

The result of the work done in St. Paul has been so satisfactory that I have no doubt that provisions for considerable additional construction will be made in the tax levy for next year, and in the interests of wheelmen I trust that equal or better work may be accomplished in other cities.

MR. TILLSON, Brooklyn, N. Y.: Probably one of the first paths ever constructed in this country for the exclusive use of bicycles was built by the Park Department of Brooklyn in 1895. Prospect Park is situated in the southwest part of the original city, and is the objective point of all the fashionable drives. From the lower end of the park to Coney Island runs a magnificent boulevard two hundred and ten feet wide for a distance of five and one-half miles. This boulevard has a sidewalk space of fifteen feet, a roadway for heavy traffic twenty-five feet wide, a park thirty feet in width, and a general speedway seventy feet wide, and the same arrangement on the other side. In 1895 a cycle path twelve feet wide was built in the park on the west side. It was constructed of broken lime stone, of the usual macadam size, and rolled and covered with a thin layer of stone not larger than one-half inch in any dimension. It cost $18,000, of which the bicyclists contributed $6,500. So popular did this path become to the wheelmen that a return path on the eastern side became as great a necessity as the original path had been a short-time before. The Legislature of 1896 authorized an issue of bonds for its construction, and early in 1896 the Department of Parks contracted for the same. This new path was built eighteen feet wide, with a foundation of gravel, covered with a three-inch layer of broken stone of ordinary macadam size. This was all thoroughly rolled with a steam roller, and then covered with stone screenings from one-half to one-quarter of an inch in size. These paths, it seems to me, make almost ideal riding. The boulevard is lined for about one-half of its distance with eight rows of trees, and the remainder of the way with six. The fall for the entire distance is, say, thirty-five feet, so that for riding it is practically level. I question if any path in the country has so much travel as these. In 1895 observation showed that 20,000 wheels passed over the first path in a single day.

MR. ADAM: We have in the city of Newark a bicycle path on one of our heaviest traffic streets. The question was with the board whether to select the side next to the curb or use the center of the street. New York city, in a few of its streets, has placed the bicycle paths on the side of the street, and I therefore recommended to the board to adopt the same method. I know many engineers in other cities who have introduced bicycle paths in the business streets have put them in the center of the street. I recommended putting the bicycle path on the side, although there might be, during the day time, obstructions from wagons, still since bicycle riding is principally done in the evening as a matter of recreation, not so much going back and forth to business, the curb line would generally be clear of wagons at that time. We have made the path four and a half feet wide, and I find that is wider than is necessary for a single passenger, and it is not wide enough for two to pass. There should be a bicycle path on each side of the street so parties going in one direction can be confined to one side of the street, and the parties coming down the street to the other side of the street. I would like to hear from any of the parties here who have had experience with bicycle paths.

MR. TILLSON: In addition to these paths, the Department of City Works has laid a number of strips of asphalt on the sides of a number of granite streets, so as to give a bicycle connection to all our smooth pavements. These strips are generally five feet in width, and have given very good satisfaction, and now wheelmen can ride over a smooth surface from almost any portion of the city to our system of improved pavements. So much has been said of the demands of wheelmen in general that it seems only just to give them the credit due their efforts for improved streets.

During the year 1897 the city of Brooklyn will lay about twenty-three miles of asphalt pavement, and in the past three years forty-three miles, and a very large portion of this good work has been accomplished by the influence of the wheelmen. Not satisfied with paths only, they have gone to the Legislature and obtained authority for the construction of entire streets connecting isolated streets, so that Brooklyn, although possessing a vast amount of poor pavements, has made wonderful strides in the right direction in the last few years, and now has a system of more than one hundred and fifty miles of improved streets, over which it is a pleasure to wheel or drive.

MR. ADAM: Why was a granite strip left between the curb and the asphalt; what was the object of that?

MR. TILLSON: Well, simply as we had, in the first place, not money enough to lay the foundation as well as we would like, we laid the granite blocks on the flat and laid the asphalt on them and then we wanted the granite blocks left in by the curb so they would take what little water might be there and prevent it from standing on the asphalt, and also because we thought it would be a good thing by throwing the wheels further out from the curb.

A MEMBER: How wide did you make those strips?

MR. TILLSON: Five feet.

MR. SHERRERD: Mr. President, it is fitting that the Society enter upon its proceedings a record of the death of its past officers. I would, therefore, move that a minute be entered by the Secretary of the death, on March 8th, 1897, of Abram Joralemon, the first Treasurer of this Society. Mr. Joralemon was a member of the Board of Street and Water Commissioners of the city of Newark, N. J., at the time of his death. He was a conscientious and painstaking man, and his interest in and labors for this Society were untiring and deserving of this recognition.

I also move that the Secretary enter a minute *in memoriam* of the death of the following members:

Prof. Conrad G. Sweensberg, President Board of Public Works, Grand Rapids, Mich., who died October 5, 1897; and

Geo. T. Sterritt, member of the Board of Administration of the city of Cincinnati, Ohio, who died during January, 1897.

Motion seconded.

THE PRESIDENT: You have heard the motion; what is the pleasure of the Society?

On taking the vote the motion prevailed.

MR. HERRMANN: I offer the following resolutions for adoption:

"RESOLVED, That we express our thanks to John L. Kennedy and other city officials, as well as the Committee of Arrangements, for the courtesies and hospitality shown during the fourth annual convention of this Society in this city. And that we also extend to the Nashville press, for the extended notices of our proceedings, our thanks; to Gov. Taylor and the Hon. A. S. Williams for their cordial welcome, and to the Nashville Street Railway Co., to Maj. J. W. Thomas, President, and Maj. J. C. Wrenne, Secretary, of the Nashville, Chattanooga & St. Louis Railroad; the Exposition Commissioners, and the owners of Belle Meade for their courtesies extended and kindness shown."

Motion seconded, and, on taking the vote, prevailed.

MR. O'BRIEN: Mr. President, I have been named as Chairman of the Finance Committee, for which I thank the members of the Society.

There is no question as to the state of the finances of this Society; some action must be taken at once to enable us to pay the bills that are due and becoming due.

Members will come to these annual meetings of the Society without the first thought of the amount of money that it takes to pay the necessary expenses; our report shows the indebtedness to be in the neighborhood of $336.00.

I do not know what the total receipts at this meeting will be, but I do know that the obligations to be met will be over $400. I do not think that the members realize that the amount is so large. Provision must be made to take care of these obligations, and when once we are out of debt we must keep out of debt. We ought not to have any more bills than last year. We all know what it cost for printing last year. It is a nice thing to have everything written for us, provided we can and do pay for the same; it is not so nice when we either cannot or do not pay for it. I will introduce a resolution to take care of the bills that are past due, but provision will have to be made to take care of the bills that are now coming in, and those that will be made after the convention adjourns.

We all have derived a vast amount of knowledge through meeting with the Society at Nashville, as well as the other places at which we have met. I think that I have journeyed as far as any other member, with the possible exception of my friends from Canada, and as on the border line between Canada and the United States there is not a great deal of distance in the length of the journey. I think that city officials who join the association, and who attend the annual meetings and participate in the discussion and vote on the various resolutions carrying the expenditure of money, should be particular that their dues are paid. The absent members of the association should also see that their dues are paid. There are quite a number of members, including those that joined at the last annual meeting, who are not here this year and whose dues are as yet unpaid. I would therefore recommend that the Secretary be instructed to at once communicate with these parties, and ask them to remit their dues.

It is no more than right that if they receive a copy of the proceedings they should see that their dues are in the hands of the Secretary, which would enable the association to at least pay for the compiling and printing of said report.

This is the third time that I have been on the Finance Committee. For two years I have made a report; the first year we were in debt $233.00, and the second $266.00.

Each and every member should respond to the request of the Secretary for the payment of dues, and each and every member should be responsible for the expenses of the meetings which are held each and every year.

Mr. O'Brien here read the resolution as follows:

"RESOLVED, That the officers of the Society be directed to prepare vouchers upon the Treasurer providing for the payment of the liabilities of the association in the following order:

"1st. A voucher in favor of August Herrmann, President, in the amount of one hundred and fifty ($150.00) dollars for moneys advanced to the Society during the past year.

"2d. A voucher in favor of A. D. Thompson, of Peoria, Ill., in the amount of fifty dollars, being the amount allowed to defray the expenses of the Paving Committee, as per recommendation of the Executive Committee as approved by the Society.

"3d. A voucher in favor of D. L. Fulton, in the amount of one hundred dollars, for services rendered as Secretary during the past year.

"4th. A voucher in favor of J. F. Galloway & Co., stenographers (the amount of the same being at the time unknown), for the payment of the expense of reporting and transcribing the proceedings of the convention.

"And be it further Resolved, That after these payments have been made, the Executive Committee shall be directed to take up and consider the question of printing the annual report, and the expense pertaining thereto."

Motion seconded.

THE PRESIDENT: You have heard the reading of the resolution and the second thereto.

MR. HERRMANN: I will say, in connection with that voucher in my favor, that when the bill came in for printing there was not enough money to meet it, and I advanced one hundred and fifty dollars to Mr. Kennedy, for which I hold his receipt.

Motion carried.

MR. RUNDLETT: Does that resolution carry the payment of the Secretary's salary for another year?

MR. O'BRIEN: For the past year.

MR. RUNDLETT: It seems to me some provision ought to be made to pay his salary for next year. Last year we passed a resolution, if I remember right, for last year. There ought to be a resolution for the payment for next year, if the Secretary has anything to do. The Secretary is the only officer that we have ever paid a salary, and he earns the money many times over. I would certainly be in favor of continuing the same salary for another year that he has received in the past. I offer a resolution that the salary of the Secretary for the ensuing year be one hundred dollars, the same as before.

MR. O'BRIEN: There is nothing in my resolution taking it away from him.

MR. BENZENBERG: The resolution last year only provided pay for last year. I second the motion of Mr. Rundlett.

Motion carried.

THE PRESIDENT-ELECT, MR. VAN DUYNE: I am now prepared to announce the committees for the ensuing year. I wish to thank the retiring President, Mr. Herrmann, and the Vice-President, Mr. Benzenberg, for the assistance given me, and also other members in making up the committees. Of course if anybody is left off any of the committees, they will understand that if they have some special matter they are studying up in their section, every one of them, we want to hear from them. They are not to think that because they are not on a committee it is not incumbent on them, and that they are excused from preparing papers that will be of interest to the next convention. If this meets with the approval of the convention, the following will be the committees for the ensuing year. [For list of committees, see pages 4 and 5.]

MR. KENNEDY: Gentlemen, our meeting is about drawing to a close. I wish to say that I am glad you have been here with us, and I hope you have enjoyed yourselves and have gotten some benefit from coming here together. There is one subject I hoped to hear something upon, a question I am greatly concerned in. I have never said much about it away from here, but you have come here to Nashville and have seen it—we are suffering very much from the smoke nuisance. You have observed that the building in which we are now sitting emits smoke to go a dozen squares. While I am not asking a committee to be appointed, I hope you will put your minds on that subject, and at the next meeting see if you cannot give us some information that will be beneficial to all cities, and that we may be able to gain some relief from the annoyance to which we are subjected.

THE PRESIDENT: Before we adjourn, I would like to ask, if possible, a meeting of the Executive Committee immediately after dinner, at about half past two o'clock. I request that there be a meeting of the Executive Committee and the new officers, that they meet in the committee room after lunch, at half past two o'clock.

MR. BENZENBERG: I wish to move you, Mr. President, that the thanks of the Society and of the convention be extended to the out-going officers for the very able manner in which they have performed the duties which were imposed upon them one year ago.

Motion seconded and carried.

On motion the Society here adjourned sine die.

INDEX.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS:

FOURTH ANNUAL CONVENTION.

PAGE.

ADDRESS:
- Of Welcome, Gov. Taylor 17- 18
- Of President of Council, Nashville 19
- Response, Pres't A. Herrmann 20
- Of Welcome, Major J. J. McCann of Tennessee Centennial. 90

AMENDMENTS:
- To Constitution proposed 40
- Adoption of 219

ANNUAL ADDRESS:
- By Pres't Herrmann 22- 27
- Referred to Executive Committee 36

ANNUAL CONVENTION:
- First Session 17
- Second Session 37
- Third Session 102
- Fourth Session 138
- Fifth Session 220
- Sixth Session 269

COMMITTEES (see Reports):
- Standing 4
- Nominating, appointment of 137
  - Report of 217
- On Next Place of Meeting, appointment of 137
  - Report of 218
  - Invitation 268
- Local, announcement 266
- New Standing, appointment of 331

COMMUNICATIONS:
- To League of American Municipalities 37
- Extending Privileges of the Headquarters of the Engineering Association of the South 102

CONSTITUTION: PAGE.
Amendments proposed ... 7- 11
Amendments adopted ... 40

ELECTION:
Of Members ... 21
Of Officers ... 217

MEMBERS:
List of (also state and city) ... 12- 16
Election ... 21

MEMORIAM:
Abram Joralemon, Newark, N. J ... 327
Prof. C. G. Sweensburg, Grand Rapids, Mich ... 327
Geo. T. Sterritt, Cincinnati, O ... 327

OFFICERS:
Election of ... 217
Responses of Newly Elected ... 218

PAPERS:
"THE PRACTICABILITY AND ADVISABILITY FOR A CITY LIKE MINNEAPOLIS TO LAY AND MAINTAIN ITS OWN ASPHALT PAVEMENTS"—By F. W. Cappelen, City Engineer, Minneapolis, Minn ... 42- 45
Discussion of same ... 73, 77, 83

"RESULTS OF ONE YEAR'S WORK WITH A CHEMICAL LABORATORY FOR TESTING ASPHALTS"—By George W. Tillson, City Engineer, Brooklyn, N. Y ... 46- 51

"ASPHALT PAVEMENTS"—By A. Rosewater, City Engineer, Omaha, Neb ... 52- 68
Discussion of same ... 68- 90

"A FEW CONSIDERATIONS REGARDING WOODEN BLOCK PAVEMENTS"—By W. A. Downing, Chairman Board of Public Works, Indianapolis, Ind ... 94- 99

"RUMBLING IN BRICK PAVEMENTS"—By Ernest Adam, City Engineer, Newark, N. J ... 100-101

"AN IDEAL SYSTEM OF HOUSETOP CONSTRUCTION"—By J. A. Cabot, City Electrician, Cincinnati, O ... 123-128
Discussion of same ... 128-131

"SOME OBSERVATIONS ON GENERAL TAXATION AND SPECIAL ASSESSMENTS"—By N. P. Lewis, Engineer, Street Commission, Brooklyn, N. Y ... 131-136

PAPERS—CONTINUED: PAGE.

"STANDARD TESTS FOR PAVING BRICK"—By M. L. Holman, Commissioner of Water Works, St. Louis, Mo 156–190

"LOCATING AND REMOVING SOURCES OF POLLUTION FROM A SERVICE WATER SUPPLY"—By M. R. Sherrerd, Engineer and Superintetendent Water Department, Newark, N. J.....205–207

"FILTERATION OF THE DAVENPORT, IOWA, WATER SUPPLY"—By E. W. Boynton, Commissioner Water Works, Davenport, Iowa 207–212

"THE RESULTS OF THE INTRODUCTION OF WATER METERS AT ATLANTIC CITY, N. J."—By W. C. Hawley, C. E., Superintendent of Water Department, Atlantic City, N. J.......213–216

"THE EXPERIENCE OF ST. LOUIS, MO., WITH RESPECT TO MUNICIPAL STREET SPRINKLING"—By R. E. McMath, President Board of Public Improvements, St. Louis, Mo..........251–254

Discussion of same.......................... 255–266

"COATING OF STEEL PIPES"—By L. W. Rundlett, City Engineer, St. Paul, Minn.................................. ...283–293

Discussion of same.......................................293–296

"TESTS OF COATING FOR STEEL WATER PIPE"—By F. W. Capelen, City Engineer, Minneapolis, Minn.................296–301

"THE LATEST METHOD OF ELECTROLYSIS PREVENTION"—By Harold P. Brown, Electrical Engineer, New York, N. Y.....303–309

Discussion of same.......................................309–312

"SCHOOL INSPECTION AS A MEANS OF PREVENTING THE SPREAD OF CONTAGIOUS DISEASES"—By J. M. Witherow, Health Officer, Cincinnati, O..... 313–316

Discussion of same..... 316–318

"BICYCLE PATHS"—By L. W. Rundlett, City Engineer, St. Paul, Minn........ 318

REPORTS:

Of Secretary........................ .... 27– 28

Of Treasurer 29– 32

Of Finance Committee..................................... 33

Of Executive Committee....................... .... 37– 40

Adoption—Executive Committee.......... 41

Of Committee on Electric Street Lighting.. 103–122

REPORTS—CONTINUED: PAGE.
Of Committee on Street Paving........ 138–147
Discussion of same...148–155
Of Committee on Sewage and Sanitation............... 191–205
Of Nominating Committee....... 217
Of Committee on Next Place of Meeting........................218
Adoption of................. 218
Of Committee on Water Works and Water Supply...............220–269
Of Committee on Disposition of Garbage and Street Cleaning.....221–223
Discussion of same...................... 224–235
Of Committee on City Government and Legislation... 236–242
Of Committee on Review............... 242–249
Discussion of same......... 249–250
Of Committee on Abolishing of Railroad Crossings in Cities......269
Of Committee on Coating of Cast Iron and Steel Riveted Pipes...270–278
Discussion of same...278–283
Of Committee on Electrolysis.................................302–303
Discussion of same......... 309–312

RESOLUTIONS:
To Dispense with Reading of Minutes....... 21
To Print Report of Secretary and Treasurer 34– 35
To Refer President's Address to Executive Committee 36
Of Thanks to the Engineering Association of the South..........102
To Continue a Committee on Coating of Cast Iron and Steel Riveted Pipes........... 301
To Continue a Committee on Electrolysis........... 312
Of Thanks to Local Committee, etc.................... 328
Directing the Payment of Bills Due..... 329
Fixing Salary of Secretary.... 330
Of Thanks to Retiring Officers................................332

353907

Fifth

ANNUAL
CONVENTION

American Society
OF
Municipal Improvements

Held at

WASHINGTON, D. C.

October 26, 27 and 28,

1898.

PROCEEDINGS OF THE

Fifth Annual Convention

OF THE

American Society
OF
Municipal Improvements

HELD AT

Washington, D. C.

◆

OCTOBER 26TH, 27TH AND 28TH,

1898

THE NEW YORK
PUBLIC LIBRARY
353907
ASTOR, LENOX AND
TILDEN FOUNDATIONS
R [illegible] L

SWAIN & TATE CO., MILWAUKEE, WIS.

American Society of Municipal Improvements.

...OFFICERS...

1898-1899.

President	NELSON P. LEWIS	New York, N. Y., Borough of Brooklyn.
First Vice President	A. D. THOMPSON	Peoria, Ill.
Second Vice President	R. H. THOMAS	Parkersburg, W. Va.
Third Vice President	B. H. COLBY.	St. Louis, Mo.
Secretary	D. L. FULTON	Allegheny, Pa.
Treasurer	J. L. KENNEDY	Nashville, Tenn.

FINANCE COMMITTEE.

F. J. O'BRIEN	Oswego, N. Y.
F. A. TWAMLEY.	Grand Rapids, Mich.
GILBERT S. VICKERY	Bangor, Me.

EXECUTIVE COMMITTEE.

The officers of the Society, together with the Past Presidents, constitute the Executive Committee. The Past Presidents are as follows:

PAST PRESIDENTS.

M. J. MURPHY	St. Louis, Mo.
GEO. H. BENZENBERG	Milwaukee, Wis.
AUG. HERRMANN.	Cincinnati, O.
HARRISON VAN DUYNE	Newark, N. J.

Standing Committees,

Appointed by President in accordance with Article IV, Section 4, of the Constitution of the Society.

1898-1899.

STREET PAVING.

EDWIN A. FISHER	Rochester, N. Y.
GEO. W. TILLSON	Brooklyn, N. Y.
FRED. GIDDINGS	Atchison, Kas.

ELECTRIC STREET LIGHTING.

DAVID HUNTER, Jr	Allegheny, Pa.
ROBERT BALLARD	Syracuse, N. Y.
THEO. A. LEISEN	Wilmington, Del.

SEWERAGE AND SANITATION.

CAPT. LANSING H. BEACH	Washington, D. C.
HORACE ANDREWS	Albany, N. Y.
JULIAN KENDRICK	Birmingham, Ala.

WATER WORKS AND WATER SUPPLY.

M. R. SHERRERD	Newark, N. J.
W. K. ELDRIDGE	Lafayette, Ind.
DAN'L. SEGER	Covington, Ky.

TAXATION AND ASSESSMENT.

AUGUST HERRMANN	Cincinnati, O.
C. C. MARTIN	Parkersburg, W. Va.
GEO. T. BOUTON	Jersey City, N. J.

CITY GOVERNMENT AND LEGISLATION.

F. W. CAPPELEN	Minneapolis, Minn.
OSCAR KNBBEL	Rochester, N. Y.
THEO. C. HEWSON	Newark, N. J.

DISPOSITION OF GARBAGE AND STREET CLEANING.

DR. W. C. WOODWARD	Washington, D. C.
ANDREW ROSEWATER	Omana, Neb.
J. H. SHIFFERENS	Buffalo, N. Y.

MUNICIPAL FRANCHISES.

BERNARD SAUNDERS	Toronto, Can.
ROBT. E. McMATH	St. Louis, Mo.
F. V. BARDOL	Buffalo, N. Y.

REVIEW.

G. H. BENZENBERG	Milwaukee, Wis.
W. B. HOWE	Concord, N. H.
GEORGE M. AMES	Grand Rapids, Mich.

Special Committees.

Appointed by President in accordance with resolutions adopted by Society,

MUNICIPAL DATA.

C. C. BROWN	Bloomington, Ill.
CAPT. LANSING H. BEACH	Washington, D. C.
A. D. THOMPSON	Peoria, Ill.

COATING OF CAST IRON AND STEEL PIPES.

L. W. RUNDLETT	St. Paul, Minn.
WM. A. LEFTWICH	Nashville, Tenn.
MAURICE J. FREIBEY	Cincinnati, O.

ELECTROLYSIS.

HAROLD C. BROWN	New York.
E. W. BOYNTON	Davenport, Ia.
CHAS. H. RUST	Toronto, Can.

NOTICE.

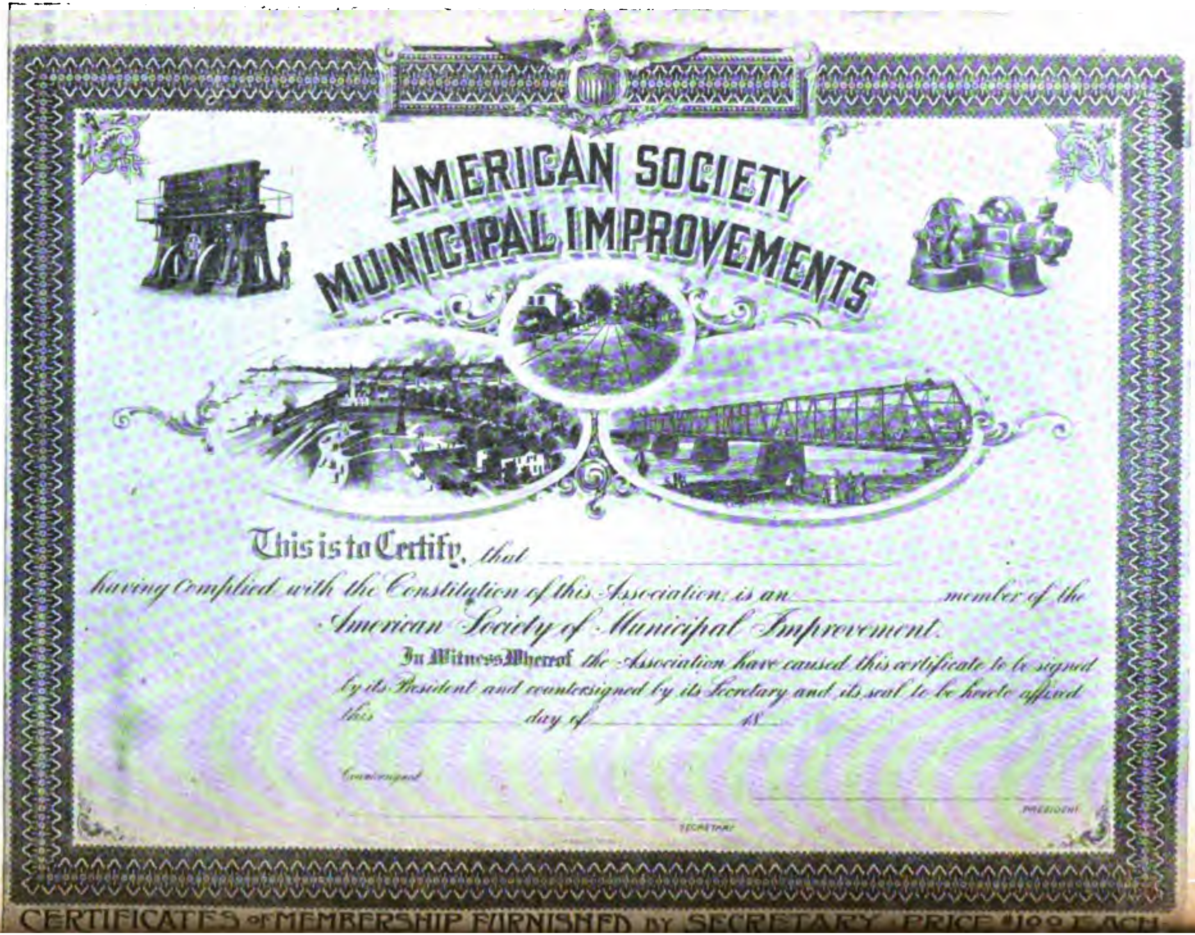
The annual reports for the former meetings are for sale by the Secretary at the following prices, including postage:

1895	25c	1897	$1.00
1896	$1.00	1898	1.00

Certificates of membership handsomely engrossed, as per illustration on opposite page, $1.00 postpaid.

Initiation fee for each city	$5.00
Annual dues per member	5.00

Address all communications to the Secretary,
D. L. FULTON,
Allegheny, Pa.



AMERICAN SOCIETY
MUNICIPAL IMPROVEMENTS

This is to Certify, that ______________________

having Complied with the Constitution of this Association, is an __________ member of the American Society of Municipal Improvement.

In Witness Whereof the Association have caused this certificate to be signed by its President and countersigned by its Secretary and its seal to be hereto affixed this __________ day of __________ 18__

Countersigned

______________________ SECRETARY

______________________ PRESIDENT

CERTIFICATES OF MEMBERSHIP FURNISHED BY SECRETARY. PRICE $1.00 EACH.

AMERICAN SOCIETY

OF

MUNICIPAL IMPROVEMENTS.

CONSTITUTION OF THE SOCIETY.

ARTICLE I.—NAME AND OBJECT.

Sec. 1. The objects of this society, which shall be known as "The American Society of Municipal Improvements," shall be to disseminate information and experience upon, and to promote the best methods to be employed in the management of municipal departments and in the construction of municipal works, by means of annual conventions, the reading and discussion of papers upon municipal improvements, and by social and friendly intercourse at such conventions, and to circulate among its members, by means of an annual publication, the information thus obtained.

ARTICLE II.—MEMBERSHIP.

Sec. 1. Any municipality within America shall be eligible to membership in this society; likewise any engineer, officer, or director who shall have charge of or supervision over, or be employed as a consulting engineer on any public or municipal department work. When a municipality has become a member of the society, then any person of such municipality representing any municipal board or department may also become a member.

Sec. 2. Every application for membership shall be in writing, stating the name, location, and department; and, if of an individual, shall also state the age, residence, and position of the applicant.

Sec. 3. Any member who shall have ceased to have charge or supervision of any public or municipal department or work may become an associate member, who shall enjoy all the rights and privileges of full membership, excepting that of holding office or voting.

Sec. 4. Any member who shall be in arrears for more than one year's dues shall be considered as no longer a member of this society, and his name shall be discontinued from the roll by the Secretary.

Sec. 5. Any member may withdraw from the society upon payment of all dues to date, and by notifying the Secretary thereof in writing.

Sec. 6. Any member may be expelled from the society upon the recommendation of the Executive Committee, adopted by a two-third vote of all the members present.

ARTICLE III.—Fees and Dues.

Sec. 1. Each municipality desiring to become a member of this society may do so by the payment of five dollars admission fee, which will entitle said municipality to as many members to said society representing boards or departments of said municipality as may be desired without any additional admission fee, but upon payment of the dues hereinafter prescribed.

Sec. 2. Municipalities shall not be required to pay any dues; but each individual representing any department of the municipality that has acquired a membership in the society, or any associate member, shall pay five dollars per annum as dues, the same to be payable on or before the date of the annual meeting.

ARTICLE IV.—Officers.

Sec. 1. The officers of this society shall consist of a President, three Vice-Presidents, a Secretary, and a Treasurer, each of whom shall be a resident of a different State, and who with the Past Presidents shall act as an Executive Committee for and in behalf of the society.

Sec. 2. There shall also be elected a Finance Committee, consisting of three members of the society.

Sec. 3. In case of any of the above positions, excepting the presidency, becoming vacant, or in case of their absence during the annual convention, the President shall fill such vacancy by appointment from the membership.

Sec. 4. There shall be appointed annually the following standing committees:

1. Street-Paving;
2. Electric Street-Lighting;
3. Sewerage and Sanitation;
4. Waterworks and Water-Supply;
5. Taxation and Assessments;
6. City Government and Legislation;
7. Disposition of Garbage and Street Cleaning;
8. Review;
9. Municipal Franchises.

The number on each committee shall be three, and the Chairman may add such names as he may deem advisable. No special or standing committee shall be authorized to create any liabilities unless the same shall have been first approved by the Executive Committee.

ARTICLE V.—ELECTION.

Sec. 1. The officers of this society shall be elected by ballot on the second day of each annual convention, and each municipality shall be entitled to as many votes as it has representatives present.

Sec. 2. The President shall not be eligible for immediate reëlection (except by a unanimous vote).

Sec. 3. The officers elected shall assume office immediately after the close of the annual meeting at which they were elected.

Sec. 4. The ballot for any officer may be waived by unanimous consent.

ARTICLE VI.—DUTIES.

Sec. 1. The President shall preside at the meetings of the society and at those of the Executive Committee, and shall perform such other duties as are incumbent upon the office. In the absence of the President, or upon his becoming ineligible, the senior Vice-President shall assume and perform the duties of the office.

Sec. 2. The Secretary shall keep accurate minutes of the proceedings of the society and of the Executive Committee; shall conduct all correspondence; shall issue notices of any meeting of the society not less than four weeks prior to the date of such meeting; shall collect and receipt for all fees and dues, and pay them to the Treasurer quarterly, taking his receipt for the same; and keep accurate account between the society and its members.

Sec. 3. The Treasurer shall receive from the Secretary and safely keep all moneys belonging to the society, giving his receipt therefor; shall pay all bills approved by the Finance Committee or the President; shall keep a correct account of the funds of the society, and submit to it at its annual meeting a report of all receipts and disbursements during the preceding year.

Sec. 4. The Executive Committee shall manage all the affairs of the society, subject to the action and approval of the society at its meeting. All questions in Executive Committee shall be decided by a majority vote, and five members shall constitute a quorum, not less than four of whom shall be officers of the society. The Executive Committee shall meet at least once each year, on the morning of the first day of the annual meeting of the society, and as much oftener as the President may determine. The Executive Committee shall be directed to keep an accurate list of the members of the society, and to ascertain from time to time whether or not such members are still municipal officers, and if not, to take such steps as may be necessary to secure new members from such cities in which members of the society are no longer municipal officers—this with a view of insuring the permanency of the association, as well as maintaining and increasing the membership thereof.

Sec. 5. The Finance Committee shall meet on the morning of the first day, and previous to the annual meeting of the society, to examine and audit the Secretary's and Treasurer's accounts and annual statements, and report thereon to the society.

Sec. 6. It shall be the duty of the Chairman of each standing committee to prepare a report, with the aid of his fellow-committeemen, and submit the same at the annual meeting.

Sec. 7. One afternoon, and such other time as may be deemed necessary, shall be devoted to sectional work, the Chairman of each standing committee acting as Chairman of the section. The Chairman of each section shall arrange the program of the sectional meetings in connection with the Program Committee of the society.

ARTICLE VII.—MEETINGS.

Sec. 1. The annual meeting of the society shall be held on the second Wednesday in October of each year, in such city as the majority of the members voting shall decide. Selection of place of meeting to be made after the officers shall have been elected. Provided, however, that the date may be changed for cause, with the approval of two-thirds of the Executive Committee, all the members to be notified of such change in accordance with Article VI, Section 2.

Sec. 2. At any annual meeting of the society fifty members shall constitute a quorum for the transaction of business.

Sec. 3. Any member, with the concurrence of the presiding officer, may admit friends to the meeting of the society, but such person or persons shall not without the consent of the meeting be permitted to take part in any discussion.

Sec. 4. All papers, drawings, etc., submitted to the meetings of the society shall be and remain the property of the society.

ARTICLE VIII.—ORDER OF BUSINESS.

Sec. 1. At the annual meeting of the society the order of business shall be as follows:

1. Roll call;
2. Reading of minutes of last meeting;
3. Considering of applications for membership;
4. The President's address;
5. Reports of the Secretary and Treasurer;
6. Report of the Executive Committee;
7. Report of the Finance Committee;
8. Reports of special committees;
9. Reading and discussion of papers;

10. Election of officers;
11. Selecting next place of meeting;
12. General business.

Sec. 2. All questions shall be decided by vote, and all differences of opinion in regard to points of order shall be settled by parliamentary practice as set forth in Cushing's Manual.

ARTICLE IX.—AMENDMENTS.

Sec. 1. The foregoing constitution and articles may be amended on or after the second day of any annual meeting of the society by a two-third vote of all members voting; provided such proposed amendment shall have been submitted to the society in writing on the first day of its annual meeting.

LIST OF CITIES HAVING A MEMBERSHIP IN THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.

Albany, N. Y.
Allegheny, Pa.
Atchison, Kan.
Akron, O.
Buffalo, N. Y.
Bloomington, Ill.
Binghampton, N. Y.
Bridgeport, Conn.
Burlington, Iowa.
Bangor, Me.
Birmingham, Ala.
Cincinnati, Ohio.
Concord, N. H.
Champaign, Ill.
Chillicothe, Ohio.
Chicago, Ill.
Covington, Ky.
Camden, N. J.
Cleveland, Ohio.
Calgary, Canada.
Dayton, Ohio.
Davenport, Iowa.
Dubuque, Iowa.
Dupont, Ga.
Eau Claire, Wis.
Ft. Wayne, Ind.
Grand Rapids, Mich.
Hamilton, Ohio.
Harrisburg, Pa.
Hamilton, Canada.
Indianapolis, Ind.
Jersey City, N. J.
Kalamazoo, Mich.
Lockport, N. Y.
Lafayette, Ind.
Lima, Ohio.
Louisville, Ky.
Los Angeles, Cal.
Memphis, Tenn.
Mansfield, Ohio.
Marietta, Ohio.
Minneapolis, Minn.
Milwaukee, Wis.
Nashville, Tenn.
Newport, Ky.
Nashua, N. H.
Newark, N. J.
New Bedford, Mass.
New Haven, Conn.
New York, N. Y.
Omaha, Neb.
Oswego, N. Y.
Ottawa, Canada.
Portland, Me.
Parkersburg, W. Va.
Peoria, Ill.
Plainfield, N. J.
Quincy, Ill.
Quebec, Canada.
Richmond, Ind.
Rochester, N. Y.
St. Louis, Mo.
Saginaw, Mich.
South Bend, Ind.
Syracuse, N. Y.
Sheboygan, Wis.
Toledo, Ohio.
Toronto, Canada.
Urbana, Ill.
Williamsport, Pa.
Wilmington, Del.
Washington, D. C.
Washington C.H., Ohio.
Youngstown, Ohio.
Zanesville, Ohio.

American Society of Municipal Improvements.

MEMBERS.

1898-1899.

Albany, N. Y.	Horace Andrews	City Engineer.
Allegheny, Pa.	David L. Fulton	Supt. Highways.
"	David Hunter, Jr.	Supt. Electric Light Plant.
"	G. C. Langenheim	City Engineer.
"	J. Linwood Brown	Supt. Bureau Water.
"	W. G. Wilkins	Associate Member.
Atchison, Kan.	Fred Giddings	City Engineer.
Bangor, Me.	Gilbert S. Vickery	" "
Binghampton, N. Y.	S. E. Monroe	" "
Birmingham, Ala.	Julian Kendrick	" "
Bloomington, Ill.	Charles C. Brown	Consulting Engineer.
Brooklyn, N. Y.	Nelson P. Lewis	Engineer of Highways.
"	Geo. W. Tillson	Princ. Ass't Engineer.
Buffalo, N. Y.	Frank V. Bardol	Chief Eng'r Dept. Pub. W.
"	Edward B. Guthrie	Ch'f En. Grade Cros'g C'n.
"	Michael J. Healy	Comr. Dept. Public Works.
"	John H. Shifferens	Supt. Street Dept.
Calgary, Can.	Charles McMillan	City Clerk.
Camden, N. J.	L. E. Farnham	City Engineer.
"	John Blowe	Street Commissioner.
"	E. S. Mills	Dept. of Streets.
Chicago, Ill.	Arthur M. Reynolds	Health Officer.
Chillicothe, O.	H. M. Redd	City Engineer.
Cincinnati, O.	A. P. Butterfield	Associate Member.
"	Alfred H. Cox	" "
"	Maurice J. Freiberg	Commsnr. of Water Works.
"	John Frey	Associate Member.
"	August Herrmann	Commsnr. of Water Works.
"	C. M. Holloway	" " "
"	L. Markbreit	" " "
"	William B. Melish	" " "
"	Geo. A. Vandegrift	Associate Member.
"	John B. Washburn	" "

Concord, N. H.	W. B. Howe	City Engineer.
Covington, Ky.	Daniel Seger	Commisn. of Water Works.
“	W. H. Glore	Supt of Water Works.
“	Thos. H. Kennedy	City Engineer.
Davenport, Ia.	E. W. Boynton	Dept. Public Works.
Dubuque, Ia.	H. B. Gliffke	City Treasurer.
Fort Wayne, Ind.	Peter Eggeman	Board of Public Works.
“	P. H. Kane	“ “ “
“	A. M. Schmidt	“ “ “
Grand Rapids, Mich.	George M. Ames	City Engineer.
“	Fred A. Twamley	Sec. Board Public Works.
Indianapolis, Ind.	B. J. T. Jeup	City Engineer.
Jersey City, N. J.	George T. Bouton	Sec. Street & Water Com'n.
“	James S. Nolan	Ch. Street & Water Com'n.
“	Chas. A. Van Kewen	Chief Engineer.
Lafayette, Ind.	W. K. Eldridge	City Engineer.
Louisville, Ky.	J. H. Pearson	Ex-City Engineer.
Marietta, O.	Philip Bachman	Councilman.
“	E. A. Cochlan	“
“	D. S. Koontz	President of Council.
“	B. F. Wood	Councilman.
Milwaukee, Wis.	Geo. H. Benzenberg	City Eng. & Chr. B. P. W.
“	S. J. Brockman	Board of Public Works.
“	Daniel B. Bush	“ “ “
“	Paul Muenzberg	“ “ “
“	Fred Schneider	“ “ “
Minneapolis, Minn.	F. W. Cappelen	City Engineer.
Nashua, N. H.	John F. Stark	Pres. Pennichuk W. Wks.
Nashville, Tenn.	John L. Kennedy	Chm. Board Public Works.
“	William M. Leftwich, Jr.	City Engineer.
Newark, N. J.	Ernest Adam	Eng. Street & Water Com.
“	Joseph M. Byrne	Commsnr. Street & Water.
“	W. E. Greathead	Clk. Board Street & Water.
“	Charles F. Herr	Commsnr. Street & Water.
“	Theo. C. Hewson	Pres. Board of Works.
“	M. F. McLaughlin	Gen'l Supt. of Works.
“	James Owen	Consulting Engineer.
“	James M. Seymour	Mayor.
“	M. R. Sherrerd	Engr. & Supt. Dept. Water.
“	W. Stainsby	Pres. Board Public Works
“	Peter Ulrich	Commsnr. Street & Water.
“	Harrison Van Duyne	“ “ “

New Bedford, Mass.	George P. Bailey	Board of Public Works.
"	Charles O. Brightman	" " "
"	William S. Cook	Clk. Board Public Works.
Newport, Ky	W. L. Glazier	City Engineer.
New York, N. Y	Harold P. Brown	Consulting Elec. Engineer.
Omaha, Neb	Andrew Rosewater	Pres. Board Public Works.
Oswego, N. Y	F. J. O'Brien	Supt. Streets.
Parkersburg, W. Va.	W. N. Chancellor	Board of Trade.
"	R. E. Horner	Pres. Board of Trade.
"	C. C. Martin	Board of Trade.
"	H. H. Moss	Pres. Board of Trade.
"	R. H. Thomas	Mayor.
"	W. W. Van Winkle	Pres. Board of Trade.
Peoria, Ill	A. D. Thompson	City Engineer.
"	Jacob A. Harman	Consulting Engineer.
Portland, Me	George N. Fernald	City Engineer.
Rochester, N. Y	Edwin A. Fisher	" "
"	Oscar Knebel	Chairman Executive Board
"	Thomas McMillan	Board Public Works.
Sheboygan, Wis	C. N. Boley	City Engineer.
Syracuse, N. Y	Robert Ballard	Alderman.
"	R. R. Stewart	City Engineer.
St. Paul, Minn	John Copeland	Pres. Board Public Works.
"	P. C. Justus	Board of Public Works.
"	L. W. Rundlett	City Engineer.
St. Louis, Mo	B. H. Colby	Sewer Inspector.
"	Robert E. McMath	Pres. Public Improvements
Toronto, Can	J. W. Burns	Board of Control.
"	A. W. Campbell	Govt. Road Commissioner.
"	John Jones	Street Commissioner.
"	E. H. Keating	Alderman.
"	John K. Leslie	Chairman Exhibition Com.
"	Charles H. Rust	City Engineer.
"	Bernard Saunders	Alderman & Chm. Works.
"	George Wilson	Secretary to Mayor.
Urbana, Ill	Arthur N. Talbot	Prof. Municipal Engineer'g
Washington, D. C.	Lansing H. Beach	Capt. Engineers, U. S. A.
"	A. W. Dow	Insp. Asphalt & Cement.
"	D. E. McCombs	Supt. Sewer Dept.
"	W. P. Richards	Surveyor.
"	A. E. Phillips	Asst. Engnr. Sewer Dept.
"	W. C. Woodward, M. D.	Health Officer.

Williamsport, Pa.	George D. Snyder	City Engineer.
Wilmington, Del.	Theo. A. Leisen	Park Engineer.
"	Harvey J. Wiley	Sec. Street & Water Dept.
Youngstown, O.	William Cornelius	Councilman.
"	M. S. Clark, M. D.	"
"	A. L. Rowland	"

PART I.

BUSINESS PROCEEDINGS

.. OF THE ..

FIFTH ANNUAL CONVENTION

.. OF THE ..

American Society of Municipal Improvements

WASHINGTON, D. C.

OCTOBER, 26, 27, 28, 1898.

AMERICAN SOCIETY

OF

MUNICIPAL IMPROVEMENTS.

FIFTH ANNUAL CONVENTION.

Washington, D. C., Oct. 26, 27 and 28, 1898.

WEDNESDAY, OCTOBER 26, 1898.—MORNING.

The Fifth Annual Convention of the American Society of Municipal Improvements met at the banquet hall of the Arlington Hotel, Washington, D. C., October 26th, 1898, at 10 a. m., and was called to order by the President, Mr. Harrison Van Duyne, who said:

"It is a pleasant duty to call the convention to order for the fifth annual meeting of the American Society of Municipal Improvements. We certainly are met in Washington under very favorable circumstances, and I am sure our meeting will be a profitable one to us all."

It was moved and seconded that the roll call and reading of the minutes be dispensed with, and the motion was agreed to.

THE PRESIDENT: I take great pleasure in presenting to the Society Commissioner John B. Wight of Washington, who will deliver an address of welcome on behalf of the municipality.

MR. PRESIDENT AND GENTLEMEN OF THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS:

It is always a pleasure to welcome to Washington those who care to make this a meeting place for their conventions, but it is especially pleasant to welcome those who are making a study of, and giving their time and attention to the subject of Municipal Improvement. It is quite fitting that those who are interested in the general subject of Municipal Improvement throughout the land should meet at the Nation's Capital, and learn what is being done and consider what is yet to be done in the improvement of this beautiful city; because they not only have an interest in it, but they have also an ownership in it.

In return for the great benefits which it was believed that the establishment of the Nation's Capitol would bring to the locality, the generous, original owners donated in effect about five-sixths of all the territory to the United States Government, and the people whom you represent own more than fifty per cent, of Washington real estate, including parks and reservations, but excluding streets and avenues, of which the Nation owns one hundred per cent.

You have a duty, then, as well as an interest in the matter, for it needs all the help and all the brain that can be procured to properly develop the Nation's Capital, so as not to perpetuate errors of judgment in the laying out of highways, parks and breathing spaces, as well as the more sombre question of sewage and other sanitary measures.

We are just on the eve of celebrating the first century of the city's history, but it should not be thought that Washington has been growing for one hundred years. For three-quarters of a century there was almost no growth at all, and the evidence that you see about you in the improvements of streets, sewers, electric railroads, etc., have been the products of the last three decades. It is the earnest desire of those who are administering the municipal affairs of this beautiful Capital, with its superb suburbs, that it should in every way be worthy of the great Nation which centers all its political interests here, and where, too, there are fast gathering the educational, social and literary interests which go to make up all that is best in a community.

Washington is distinctly a residential city. While it is true that the last census shows it is engaged in manufacturing interests to an extent that is perhaps surprising—standing fourteenth in proportion to the population, paying more than a million dollars each month in wages, not including the large sums of money paid by the United States Government for the manufacturing done at the gun plant in this city—and while it is also true that if the tremendous power created at the Great Falls of the Potomac could be utilized as the small streams are utilized all through New England, Washington might be vastly more of a manufacturing city, without, perhaps, endangering it in other respects, it is true that it is, at present, almost wholly a residential city; and the probability is that each year will see added to this class of people many of those who, having retired from business, will be glad to make their homes here for the sake of the pleasures to be found here as they can be found nowhere else.

The position of the city as regards finances and expenditures is quite unique and interesting. Reference has been made to the fact that the Government of the United States owns a very large proportion of the property in the city. For a great many years little or no recognition was made of this fact by the United States Government, and the citizens of Washington, few in number and not of great wealth, were called upon to pay all the expenses incident to the carrying on of the District of Columbia, including the improvement of the streets around the public buildings, the Police Department, the Fire Department, the maintenance of the Public Schools, and everything that went to make up the budget of municipal expenses, although they were deprived of the revenue from more than one-half of the property. Congress, at last, was brought to a realization of its responsibilities in the matter and of the equities in the case, and in 1878 a law was passed, under which the Government is now administered, in which it was provided that estimates for carrying on the expenses of the city should be submitted to Congress, and that, to the extent that Congress should approve of these estimates, the Government should pay one-half of the amount appropriated. This, at times, is looked upon by new-comers to Congress, who do not realize the situation or fully appreciate the importance of the development of their Nation's Capital, with some jealousy. It seems to them as though they would be very glad to have the Capital located in their own towns if they could receive such munificent appropriations, and they rather begrudge what they are pleased to call the "half and half system"; but it is seldom the case that when men of fair minds become fully acquainted with the real situation, they begrudge these appropriations.

The municipality is administered by three Commissioners, appointed by the President of the United States, two of them being civilians, and the third an army officer of the Engineer Corps, detailed by the President to act as a Commissioner. The duties pertaining to the city are divided among these three Commissioners, each one of whom looks after the details of the duties assigned to him, it requiring, however, the approval of at least two of the three Commissioners to secure action. The accounts are carefully examined by the officers of the United States Treasury, both as to the amounts paid and the nature of the expenditures. All expenditures of one thousand dollars or more are required by law to be under contract, and notice given through the Washington papers that proposals will be received, and when the amount exceeds five thousand dollars, notice is not only given in the Washington papers, but in the New York papers and the papers of other cities.

It is claimed, and justly so, I think, that this form of government is the most economical of any city in the country, and is certainly, in view of all considerations, the best that could be devised for the District of Columbia.

The Constitution of the United States provides that in the establishment of this location as the permanent seat of the Nation's Capital Congress shall have power "to exercise exclusive legislation" over it "in all cases whatsoever." Congress has, however, delegated to the Commissioners the right to make local police regulations, and such laws as are usually applicable to the administration of minor municipal matters.

You are to learn, from papers which will be read here by gentlemen connected with the District Government, what has been done up to this time in the matter of improvements in streets, alleys, etc. We believe that we have made a fair beginning; we believe that we are on the right track as to the work which is now being done, and that which we propose to do; we believe that we have been wise in excluding, as we hope we have, the over-head trolley and those things which go to disfigure the city; we believe that we have the best street-car system in the world; that our wide streets and beautiful avenues, adorned with abundant foliage, should be extended into the suburbs, so that, in the course of a comparatively short time, the distinction which is now made between the City of Washington and the Suburbs, or the County, will be done away with, and it will be one beautiful city, laid out and built up on the magnificent plan adopted one hundred years ago.

We beg you to bear in mind, as you inspect our city and see, as you probably will, some defects which you think should not exist, that we are doing the best we can with the rather meagre amount of money which Congress allows us each year; that already plans have been perfected by which the steam railroads will remove their tracks from the streets and do away with the objectionable and deadly grade crossings; that the unsightly and unhealthy Eastern Branch flats, which are such a menace to health, are soon to be reclaimed; that a recent law of Congress will enable us, within a very short time, to compel every house to be connected with running water and supplied with the latest sanitary conditions; that a careful study is being made of the subject, with the expectation that soon legislation will be passed, enabling us to take down every over-head wire that now exists and put it under ground.

These things naturally appeal to you, not only as those interested in the subject of Municipal Improvement, but doubly so because of your rights and interests in the National Capital. We will be glad to have your help in securing its development, your suggestions and your assistance; and we venture to express the hope that your stay among us may be pleasant and agreeable, and that it will result in a clearer understanding and appreciation of the relations which exist between the District and the Federal Government; in a hearty coöperation on your part, and through you that of your representatives in Congress, in the effort to have our great country fitly represented here in the city selected for its National Capital.

THE PRESIDENT: Mr. Commissioner, I am sure the members of the convention have been especially interested in listening to your account of the improvements which have been made in Washington. Those of us who came here early have enjoyed driving and walking around your beautiful city and I am sure we have seen many things that will be of advantage to us in advancing the improvements of our own cities.

As President it is my duty to deliver a brief address and I will proceed to do so now.

TO THE MEMBERS OF THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS:

Since the last convention of the American Society of Municipal Improvements, in Nashville, Tenn., great events have occurred in this country, adding a new chapter to its history, the far-reaching effects of which we may not yet realize.

We know, however, that while we have been wonderfully successful in the war with Spain and in the direct results growing out of the war, we could hardly have foreseen the importance of the events indirectly resulting from it.

Dewey and Sampson and Schley have demonstrated to the world the power of the American navy. England and America, with so many interests in common, have had much of the old bitterness of feeling removed; and above all, we have become a united people in heart as well as in name, and ready to work together for the common good of all.

The general government has had a severe experience this year with the dangers arising from assembling large bodies of men together, and has found that the best possible sanitary arrangements must be made to protect their health.

People crowd into our cities, and the members of this Society, representing as they do the governing and working power of so many cities, have a special responsibility resting upon them.

Are the streets and avenues of your city in good condition, and are they kept clean? Is your city properly sewered, and have you a water supply uncontaminated and kept in such condition that your health and that of your families is not endangered by drinking it? In answering these questions we realize how much the health and comfort of the hundreds of thousands of people we represent is placed in our care.

We come together once a year to listen to the reading of carefully prepared papers, by some of our members, on the various subjects relating to city improvements, and in the discussions which follow the actual experience of the different cities is clearly brought out; but in addition to that, the visits made by us each year to a different one of our larger cities, enabling us to study on the ground the best work done in each, give us all an experience and training that must be of great advantage to the city we represent.

Our first meeting was held in Buffalo, probably the first city in this country to decide that smoothly-paved and clean streets were a necessity; and its citizens and officials must have had the courage of their convictions to show by their example what a progressive city could do.

Three years ago we met in Cincinnati, an idéal convention city, built on its seven hills, its inclined plains and stationary engines making easy access to their very top. Miles of finely paved streets and its extensive sewer construction showed it to be another of our very progressive cities, and in its hospitality it could not easily be excelled.

Two years ago we were in Chicago, that marvel of the West, with its beautiful parks and fine suburban drives. To improve its sewer system it has not hesitated to change the course of a river, and some day it will be at the head of navigation of the Mississippi.

Last year we were at Nashville, Tenn., a city with energy enough to successfully carry on a great Exposition, and which will easily in its improvements rank as one of the foremost cities of the South. And this year we come to the National Capital, the city in which we all feel a personal interest and a special pride; and in passing through its finely paved streets and avenues, and in admiring its beautiful parks and public grounds, we fully realize that thoroughly trained and conscientious men are at the head of the public work in Washington.

At the convention held last year, our Committee on Street Paving recommended, among other things, that where a contractor was required to guarantee his work for a term of years, especially in asphalt pavement, the condition of the pavement at the end of the term should be specifically stated. The City of Newark this year partly adopted these suggestions, and instead of paving with asphalt under specifications calling for a five-year guarantee with indefinite requirements, now requires a ten-year guarantee under bonds given by a responsible Trust Company, and the exact condition in which the pavement is to be at the end of that term, in order to be accepted, is stated. Under the old specifications, for several years only Trinidad Lake asphalt was used; last year the bidders were limited to four different kinds, and this year, under the more severe and definite specifications, the door was thrown wide open to all asphalts. Any responsible company or individual giving approved bonds is given the contract, provided the bid is the lowest.

The first asphalt laid in Newark was in the year 1890, and from that time until 1894 it cost about $2.85 per yard. This was laid by the Barber

Asphalt Company, and virtually without competition; last year the price got down to $2.35 per yard, and this year, with the ten-year guarantee, but open to all, the price has been about $1.50 per yard. The city, however, agrees to pay, in addition to that amount, 25 cents per yard for the second term of five years, for maintenance and repairs.

We have also required this year a five year guarantee on oblong granite block pavement; notwithstanding which the price has been reduced from about $2.50 per yard in 1893 and 1894 to $1.50 per yard this year when laid on sand, and in like proportion when laid in concrete. Perhaps I should add that New York City, only nine miles away, stopped almost entirely its paving work this year, and that may have helped to reduce the price to the neighboring cities.

In all our progressive cities, and we all want to be considered progressive, the conditions are now entirely different from fifteen years ago. Even Washington at that time, or a little earlier, had an unenviable reputation for the condition of its streets, and a number of other cities gloried in their cobblestone pavements.

But the great advance made during the last few years in city development has taken a large amount of money, the annual outlay for expenses has been greatly increased, municipal bonds are becoming a burden; and as a natural result there is such an increase in the tax rate as to cause alarm to many citizens.

During this same time in all our cities a wonderful advance has also taken place in the value of the franchises which have been given to so many companies, to use the public streets to carry on their business.

These franchises are worth nearly as much as the land fronting on the streets through which their grants and privileges extend. They have a recognized value to buy and sell and their earnings and dividends bear out that value; but when it comes to the valuation on which they pay taxes there is a wonderful drop, and the result is that they bear only a small part of the public burdens that properly belong to them, and the tax burdens of others are proportionally increased. I know of no reason why, according to the true value of these properties, they should not contribute their share to the support of the public schools, to the cost of maintaining our courts, and all the other expenses of city and state government, the same as other property.

True, in nearly all cases these franchises were given away as if they had no value, but is that any reason why, after their enormous value is fully established, they should not be treated as other property and annually contribute their full share to the tax collector?

Beyond our churches and schools and charitable institutions, we want no favored class, and our influence should be exerted to see that all property stands equally before the law.

In conclusion, I wish again to thank the members of this society, for myself, and on behalf of the city of Newark, which I am privileged to partly represent, for the honor of being chosen as President, and I trust this convention will be a source of great profit to us all.

THE PRESIDENT: The next business on the program is the consideration of applications for membership.

The following names were presented for membership, and on motion the Secretary was instructed to cast the vote of the association, declaring them duly elected members of the society.

Horace Andrews, Albany, N. Y.
Gilbert S. Vickery, Bangor, Me.
W. C. Woodward, Washington, D. C.
W. F. McFarland, Washington, D. C.
A. W. Dow, Washington, D. C.
W. P. Richards, Washington, D. C.
A. E. Phillips, Washington, D. C.
W. Burns, Toronto, Canada.
C. H. Rust, Toronto, Canada.
George Wilson, Toronto, Canada.
A. W. Campbell, Toronto, Canada.
Oscar Knebel, Rochester, N. Y.
Maurice J. Freiberg, Cincinnati, O.
C. M. Holloway, Cincinnati, O.
L. Markbreit, Cincinnati, O.
William B. Melish, Cincinnati, O.
Theodore A. Leisen, Wilmington, Del.
Daniel Bush, Milwaukee, Wis.
William M. Leftwich, Jr., Nashville, Tenn.
James M. Seymour, Newark, N. J.
Theodore C. Hewson, Newark, N. J.
Joseph M. Byrne, Newark, N. J.
M. F. McLaughlin, Newark, N. J.
James Owen, Newark, N. J.
Charles A. Van Kewen, Jersey City, N. J.
James S. Nolan, Jersey City, N. J.
George T. Bouton, Jersey City, N. J.
Julian Kendrick, Birmingham, Ala.
Michael J. Healy, Buffalo, N. Y.
Frank V. Bardol, Buffalo, N. Y.

THE PRESIDENT: The next business is the report of the Secretary.

The Secretary, Mr. D. L. Fulton, read the following report:

REPORT OF THE SECRETARY.

ALLEGHENY, PA., OCT. 21, 1898.

TO THE AMERICAN SOCIETY MUNICIPAL IMPROVEMENTS:

SIRS: I have the honor to present the following report as your Secretary for the past year, beginning October 1, 1897, and closing October 10, 1898:

RECEIPTS.

Initiation fees from two cities	$10.00
Dues from 101 members	303.00
Certificates of membership, 10	10.00
Two reports of 1895 at 25 cents	.50
Nine reports of 1896 at $1.00	9.00
Two hundred sixty-nine reports 1897 at $1.00	269.00
Total	$601.50

DISBURSEMENTS.

Oct. 8, 1897, paid Treasurer Kennedy	$240.00
Nov. 19, 1897, paid Treasurer Kennedy	60.25
Oct. 10, 1898, paid Treasurer Kennedy	56.00
Oct. 11, 1898, paid Treasurer Kennedy	.40
Total	$356.65
Sept. 10, 1898, paid Swain & Tate Co	$125.00
Oct. 5, 1898, paid Swain & Tate Co	50.00
Oct. 11, 1898, paid Swain & Tate Co	69.85
Total	$244.85

RECAPITULATION.

Received from all sources		$601.50
Paid treasurer	$356.65	
Paid Swain & Tate Co	244.85	
	$601.50	$601.50

The reason for paying the bill of Swain & Tate Co. of Milwaukee, Wis., for publication of last annual report, the amount of $244.85, was that the money for the extra reports was sent direct to me to save confusion, from the fact that I am delegated to disburse the reports; as the money came in I paid it direct to the above firm, taking their receipts for same, which have been forwarded to the Treasurer, Mr. John L. Kennedy.

Our President, Mr. Harrison Van Duyne of Newark, N. J., kindly came to the relief of the society in advancing one hundred dollars to help pay the printing bill, so that with the money he advanced and the amount received from extra copies we have been able to pay the bill in full.

Our attendance at Nashville last fall was below the average and is to be accounted for from the fact that yellow fever existed in the South at that time and many were deterred from attending on that account.

During the past year I have carried on the correspondence of the society and answered all letters of inquiry sent me to the best of my ability, and have tried in all cases to stimulate interest in the society and get our cities interested in the great work before us.

All the members of the several committees have been notified of their appointment, and I have sent notices to all members as well as those persons who have been members, but who have not been in attendance for several meetings; I have also sent invitations to many city officials, whose names I have secured, who have never have attended our meetings.

I helped all I could in the preparation of our last annual report, and may say that the society is much indebted to its President, Mr. Van Duyne, Past Presidents, Messrs. Benzenberg and Herrmann, for the excellence of the annual report.

Much delay was caused by matters in connection with the last report after it reached the Secretary, which could not be remedied any sooner and which are not likely to occur again.

I would recommend that all the members send the Secretary the names of any city officials who would likely be interested in our society, so that he could communicate with them and try to get them to become members of this organization, and each member should also do his best to get his neighboring city officials interested so that our work may be put in the hands of all our cities and our membership increased.

Thanking the members and officers for their kind assistance, I am, most respectfully,

D. L. FULTON,
Secretary.

THE PRESIDENT: Gentlemen, you have heard the report of the Secretary. What is the pleasure of the convention with reference to this report?

MR. BENZENBERG: I move the report be received and referred to the Finance Committee.

The motion was agreed to.

THE PRESIDENT: The next report in order is that of the Treasurer. I will state that the Treasurer, Mr. John L. Kennedy, was unavoidably prevented from being with us at this meeting. He has sent on his report to me and I have handed it to the Finance Committee. The Secretary will read his report, to which you will now listen.

The Treasurer's report was read by the Secretary, as follows:

REPORT OF THE TREASURER.

TO THE HONORABLE, THE FINANCE COMMITTEE OF THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS, IN SESSION AT WASHINGTON, D. C., OCTOBER, 1898:

The undersigned hereby exhibits an account of his receipts and disbursements as Treasurer of the said society during the third year in which he has served in that capacity, beginning October 5, 1897.

CASH RECEIPTS.

1897.		
Oct. 5th	Am't cash on hand as per settlement approved by your Finance Committee	$25.93
Oct. 8th	From D. L. Fulton, Secretary	240.00
Oct. 8th	From L. W. Rundlett for copy of report of 1896	1.00
Nov. 10th	From D. L. Fulton, Sec'y, as per his letter Nov. 10th, 1897	60.25
1898.		
Oct. 8th	From D. L. Fulton, Sec'y, as per letter, Oct. 6th, 1898	56.00
Oct. 17th	From D. L. Fulton, Sec'y, as per letter Oct. 13th, 1898	.40
		$383.58

DISBURSEMENTS.

1897.		
Oct. 30th	Paid T. A. McNairy's account of Sept. 30th, 1897, for stationery, etc. Approved by Secretary Fulton and President Herrmann	$11.80
Oct. 30th	Paid D. L. Fulton's account, for stamps and expressage. Approved by Secretary Fulton and President Herrmann	4.56
Nov. 3d	Paid A. D. Thompson, expense Committee on Street Paving	50.00

Nov. 3d....	Paid August Herrmann, for amount advanced to society Feb. 27th, 1897	150.00
Nov. 16th..	Paid J. F. Galloway & Co. on account ($97.50), for reporting proceedings of the fourth annual meeting of the society. Approved by Secretary Fulton and President Van Duyne	50.00
Nov. 19th..	Paid J. F. Galloway & Co. balance of said account..	47.50
1898.		
Mar. 11th..	Paid T. A. McNairy, for stationery, etc. Account approved by Secretary and President Van Duyne	6.90
Oct. 8th...	Paid D. L. Fulton's account for postage, expressage, etc. Approved by President Van Duyne	56.10
		$376.86
	Amount now in treasury	6.72
		$383.58

For the accounts paid as above shown, the receipts of the parties to whom payments were made are herewith submitted and for the balance shown to be in the treasury—$6.72—a certificate of deposit in the Fourth National Bank of Nashville, Tenn., payable to the order of your Treasurer, is also herewith exhibited.

RECAPITULATION.

Cash on hand at last settlement		$25.93
Received from L. W. Rundlett		1.00
Received from D. L. Fulton, Sec'y		356.65
Total		$383.58
Disbursed:		
Sundry accounts	$376.86	
Cash in treasury	6.72	$383.58

The foregoing statement shows all the transactions of your Treasurer, but he is pleased to add that our worthy Secretary, Mr. D. L. Fulton, reports that he has received cash as follows:

For 269 reports of meeting of 1897, at $1.00 each	$269.00
Annual dues from 101 members, at $3.00 each	303.00
Initiation fees from two cities, at $5.00 each	10.00
Ten certificates of membership, at $1.00 each	10.00
Two reports of meeting of 1895, at 25 cents	.50
Nine reports of meeting of 1896, at $1.00	9.00
Total	$601.50
Of this amount he paid to your Treasurer as above shown	356.65
Leaving to be accounted for by the Secretary	$244.85

The Secretary has submitted to your Treasurer the receipted bill of Swain & Tate company of Milwaukee for printing 500 copies of the proceedings of our Fourth Annual Convention. Said account being approved by Mr. G. H. Benzenberg of the Executive Committee and being

for	$344.85
On this said amount our worthy President, Harrison Van Duyne, paid from his own means	100.00
Leaving a balance on said account of	$244.85

This balance was paid by the Secretary from the funds collected by him as hereinbefore shown, and he thus balances his account with your Treasurer.

The said receipted bill of the Swain & Tate company is herewith submitted.

It will now be observed that the society is indebted to President Van Duyne for money advanced by him, as above shown, in the sum of $100.

It may also be noted that at our annual meeting in 1897 it was agreed that our Secretary should be paid $100 for his services, which amount has not been paid for want of funds.

All of which is respectfully submited, this October 25, 1898.

JOHN L. KENNEDY,
Treasurer of American Society of Municipal Improvements.

The President: You have heard the report of the Treasurer. I suppose the report of the Finance Committee should come in immediately following the report of the Treasurer, before action is taken upon it.

The report of the Finance Committee was read by its Chairman, Mr. F. J. O'Brien, as follows:

REPORT OF FINANCE COMMITTEE.

American Society of Municipal Improvements:

Gentlemen:

Your Committee on Finance would report that they have examined the report of the Treasurer, checked up the receipts and vouchers for disbursements, and find the same to be correct.

The Treasurer's books show that there is apparently now on hand in the treasury a balance of $6.72, and we find on further investigation that there is an outstanding indebtedness as follows:

Secretary's salary	$100.00
President Van Duyne, for money advanced	100.00
Sundry small bills	10.00
Making a total deficiency of	$203.28

There has been collected from all sources the sum of $60.50, which we find is not enough money to run the Society as it is run at present.

Your Committee would therefore recommend that the annual dues be increased to $5.00 per annum, in order that we may pay our debts when they become due. Respectfully submitted,

F. J. O'BRIEN,
Chairman.

THE PRESIDENT: Gentlemen, you have heard the report of the Treasurer and the report of the Finance Committee. What is your pleasure in reference to these reports?

On motion the reports were received and placed on file.

THE PRESIDENT: Next in order is the report from the Executive Committee, which will be presented by Mr. George H. Benzenberg.

The report of the Executive Committee was read by Mr. Benzenberg, as follows:

REPORT OF EXECUTIVE COMMITTEE.

WASHINGTON, D. C., OCTOBER 26TH, 1898.

TO THE MEMBERS OF THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS:

GENTLEMEN:

After a general discussion of the affairs of the society, your committee recommends that the constitution be amended as follows:

Amend Article 7, Section 1, as follows: After the word "decide" add the following:

Provided, however, that the date may be changed for cause with the approval of two-thirds of the Executive Committee, all the members to be notified of such change in accordance with Article 6, Section 2.

Your committee also recommends that Article 3, Section 2, of the constitution be amended to read as follows:

Article, 3, Section 2, Fees and Dues: Municipalities shall not be required to pay any dues, but each individual representing any department of the municipality that has acquired a membership in the society, or any associate member, shall pay $5.00 per annum as dues, same to be payable on or before the date of the annual meeting.

Your committee further recommends that Article 6, Section 4, shall be amended by adding to said section the following paragraph:

The Executive Committee shall be directed to keep an accurate list of the members of the society, and to ascertain from time to time whether or not such members are still municipal officers, and if not to take such steps as may be necessary to secure new members from such cities in which members of the society are no longer municipal officers. This, with a view of insuring the permanency of the association, as well as maintaining and increasing the membership thereof.

Under Article 9, Section 1, of the constitution any proposed amendment must be submitted in writing on the first day of the annual meeting. This section also provides that the constitution may only be amended on or after the second day of any annual meeting of the society by a two-thirds vote of all the members voting. We therefore recommend that this report be made a special order for 2:30 o'clock to-morrow.

Respectfully submitted,
G. H. BENZENBERG.
AUG. HERRMANN.
D. L. FULTON.
HARRISON VAN DUYNE.
A. D. THOMPSON.

On motion the report of the Executive Committee was made the special order for to-morrow at 2:30 p. m.

THE PRESIDENT: The morning has been occupied principally in presenting the reports of the officers. One committee report is, however, on the program for this morning's session, that of the "Committee on Electric Street Lighting." Is Mr. F. W. Cappelen, City Engineer of Minneapolis, present?

THE SECRETARY: Mr. President, he has sent me his printed report, stating that he hoped to be here, but asking me to present his report in case he could not come.

MR. HERRMANN: We have never gone into the presentation of papers at our first morning's session and I therefore move that this report be postponed till the evening session and that we take a recess until 2 o'clock.

The motion was agreed to.

Accordingly the society took a recess until 2 o'clock p. m.

WEDNESDAY, OCTOBER 26, 1898.—AFTERNOON.

The President: The session this afternoon will be mainly given to the Committee on Sewerage and Sanitation, and the first paper is a report upon the "Utilization of Sewage of Vienna, Austria," a translation by Capt. Lansing H. Beach, Engineer Commissioner of Washington. I know we shall all be glad to hear from Captain Beach.

Captain Beach: I wish to state that this paper is strictly a translation of a report made to the Austrian Government by a commission of experts appointed by the government for the purpose of determining the fertilizing value of the sewage of the city of Vienna. There are no comments and no remarks in the text of it. The report has been cut down considerably, and I hope you will not find it too long as it is.

* * * * * * * *

(See part II. for all Reports of Committees, Papers and Discussions thereon.)

* * * * * * * *

Thereupon the convention adjourned until 8 p. m.

OCTOBER 26, 1898.—EVENING.

The convention was called to order at 8:15 o'colck p. m. by the President:

The President: The first report for the evening session is the report of the Committee on Taxation and Assessment. Mr. August Herrmann, President of the Board of Trustees, Commissioners of Waterworks, Cincinnati, Ohio, is the Chairman.

Mr. Herrmann: Mr. Chairman and Gentlemen, our committee has no report. I believe I am the only member present, although I understand that Mr. Horner will be here to-morrow. I have, however, prepared a paper entitled "Rates of Taxation in the Larger Cities of the United States," and with your permission I will read it to you.

* * * * * * * *

(See Part II. for all Reports, Papers, etc.)

* * * * * * * *

THE PRESIDENT: The constitution of our society provides that on the second day of the annual meeting officers for the ensuing year shall be chosen, and also the place selected for the next meeting of the society. It has been customary to name on the previous day a committee of five members on each of these subjects.

CAPTAIN BEACH: I move that the custom be followed.

THE PRESIDENT: Then the motion will be that two committees, of five members each, be chosen, one to nominate officers and the other to suggest a place of meeting for the next convention.

The motion was agreed to.

THE PRESIDENT: How will you choose the committees? First, the Committee to Nominate Officers.

MR. BENZENBERG: I think the selection of the committee should be made by the members of the association in making nominations.

The following nominations were then made for members of the Committee to Nominate Officers for the ensuing year:

Mr. A. D. Thompson, of Peoria, Ill.
Mr. G. H. Benzenberg, of Milwaukee, Wis.
Mr. August Herrmann, Cincinnati, Ohio.
Mr. M. R. Sherrerd, of Newark, N. J.
Capt. Lansing H. Beach, Washington, D. C.

Nominations were closed, and the Secretary was directed to cast the ballot of the association for the five gentlemen above named as the Committee on Selection of Officers for the ensuing year, which he accordingly did.

THE PRESIDENT: We will next proceed to the nomination of a Committee to Select the Place of Meeting next year.

The following nominations were made:

Bernard Saunders, of Toronto, Canada.
S. J. Brockman, of Milwaukee, Wis.
Charles F. Herr, of Newark, N. J.
N. P. Lewis, of Brooklyn, N. Y.
M. L. Holman, of St. Louis.

Nominations were closed, and the Secretary was directed to cast the ballot of the association for the five gentlemen above named as the Committee to Select the Place of Meeting for next year, which he accordingly did.

The President stated that he had in his possession a letter from the Mayor and Board of Trade of Niagara Falls, inviting the convention to meet there next year; also a letter from the Mayor of Detroit, inviting the convention to meet at Detroit. The Secretary stated that he had a letter enclosing a resolution from the council at Toronto, asking the society to meet there next year.

On motion these letters were referred to the committee on that subject.

THE PRESIDENT: The report of the Committee on Electric Street Lighting was laid over this morning. Mr. Cappelen has been unable to be present, and the Chair suggests that the Secretary read the report.

CAPTAIN BEACH: I move that the report be read by title.

The motion was agreed to.

THE PRESIDENT: It will be read by title, and the members will be furnished with printed copies as far as can be done.

Thereupon the Secretary read the title, as follows:

"Fifth Annual Convention American Society of Municipal Improvements, Washington, D. C., October, 1898. Report from the Committee on Electric Street Lighting, F. W. Capellen, City Engineer, Minneapolis, Minn., Chairman."

* * * * * * * *

(See Part II. for all Reports, Papers, etc.)

* * * * * * * *

THE PRESIDENT: That finishes the program for this evening, unless there are some volunteer papers.

CAPTAIN BEACH: If in order at this time I should like to nominate Mr. Warner Stutler, Superintendent of Street Cleaning, Washington, D. C., and Mr. C. B. Hunt, Computing Engineer of the District of Columbia, as members of this society.

Mr. Stutler and Mr. Hunt were accordingly unanimously elected members of the Society.

THE PRESIDENT: There is a matter to which I would like to call the attention of members. I received a letter from the Vice-President of the United States, Mr. Hobart, to Mr. Porter, the Secretary of the President, which I have brought with me to Washington with a view of arranging for a reception of this society at the White House. As you all know the President is to-day visiting at Philadelphia, at the Peace Jubilee there, and will not be back until some time Friday. Mr. Porter says that early on Saturday afternoon, if any considerable number of our members expect to remain over, arrangements will be made for such a reception. Can I get any idea of the number who will remain?

A MEMBER: I understand that on account of the rain to-day the city parade in Philadelphia will be put over until Friday.

THE PRESIDENT: I do not know whether that will cause the President's visit to Philadelphia to be lengthened by one day or not.

A MEMBER: We will all be there.

THE PRESIDENT: I understand, then, that nearly all expect to be here on Saturday afternoon.

Is there anything else to be brought before the convention at this time? If not, a motion to adjourn is in order.

On motion the convention adjourned to meet, as per program, at 2 o'clock p. m. to-morrow, October 27th, 1898.

SECOND DAY.

THURSDAY, October 27, 1898.
2 O'clock p. m.

THE PRESIDENT: The time has come for the report of our Committee on Street Paving. I know we shall need all the afternoon in hearing from them and in discussing their report. You will listen to the report of the Committee on Street Paving by the Chairman, Mr. N. P. Lewis, Engineer of Highways of Brooklyn. The subject of his paper is "The Construction of Surface Railroad Tracks in Paved Streets." But before introducing Mr. Lewis I think there are some new members to be proposed.

The following gentlemen were then unanimously elected members of the society:

James S. Nolan, member of the Board of Street and Water Commissioners, Jersey City, N. J.

Charles A. Van Kuren, Chief Engineer of the Board of Street and Water Commissioners, Jersey City, N. J.

George C. Bouton, Secretary of the Board of Street and Water Commissioners, Jersey City, N. J.

THE PRESIDENT: Now we will take pleasure in hearing from Mr. Lewis.

* * * * * * * *

(See Part II. for Reports, Papers, etc.)

* * * * * * * *

MR. BENZENBERG: Before we proceed to close I wish to call attention to the fact that there was a special order of business set for 2:30 o'clock this afternoon, which has not yet been taken up.

THE PRESIDENT: That is a fact. It was overlooked.

MR. BENZENBERG: I would like to have some action taken or else have the special order postponed to some definite time.

THE PRESIDENT: The proposed amendments to the constitution were made the special order for this afternoon, but it was forgotten when the meeting was called to order. If the Secretary will read the amendments I think we can act upon them probably before adjournment. The amendments are presented by the Executive Committee.

THE SECRETARY: The first amendment is:

> That Article 7, Section 1, be amended as follows:
>
> "After the word 'decide' add the following:
>
> "Provided, however, that the date may be changed for cause with the approval of two-thirds of the Executive Committee, all the members to be notified of such change in accordance with Article 6, Section 2."

THE PRESIDENT: That amendment is suggested to give a little leeway as to the time of holding the convention. It seems almost necessary that there should be a provision of that kind in the constitution.

On motion of Mr. Benzenberg the amendment was adopted.

THE SECRETARY: The committee also recommends that Article 3, Section 2 of the constitution be amended to read as follows:

> "Article 3, Section 2: Municipalities shall not be required to pay any dues, but each individual representing any department of a municipality that has acquired a membership in the society, or any associate member, shall pay $5.00 per annum as dues, the same to be payable on or before the date of the annual meeting."

THE PRESIDENT: That is really a change in the amount from $3 to $5. It seems to be necessary, as the $3 dues has not produced enough revenue to run the society.

MR. SHERRERD: Does it do away with the municipalities paying dues at all?

THE SECRETARY: The municipalities do not pay any dues now.

MR. BENZENBERG: The municipality has never had to pay any dues. The admission fee is paid by the municipality, but the annual dues are paid by the delegate representing the city.

MR. LEWIS: Mr. President, whilst this amendment is under discussion I should like to ask a question. It is not clear in my mind now as to what happens to the membership of the different cities if they fail for one year to send any representative whatever to this convention. Is it a fact that a city once a member is always a member?

THE PRESIDENT: I think so.

MR. LEWIS: And its membership can be resumed at any time?

THE PRESIDENT: I think so.

The amendment to Article 3, Section 2, above stated, recommended by the Executive Committee, was unanimously adopted.

THE SECRETARY: The committee further recommends that Article 6, Section 4, be amended by adding to that section the following paragraph:

> "The Executive Committee shall be directed to keep an accurate list of the members of the Society, and to ascertain from time to time whether or not such members are still municipal officers, and, if not, to take such steps as may be necessary to secure new members from such cities in which members of the society are no longer municipal officers. This with a view of insuring the permanency of this Association, as well as maintaining and increasing the membership thereof."

MR. SHERRERD: I move the adoption of that amendment.

The motion was seconded.

MR. ANDREWS: I should like to inquire whether when a municipal officer goes out of office that discontinues his membership in the society.

THE PRESIDENT: There is a provision in the constitution now that he may continue as an associate member, having all the rights, privileges and powers of a member except the right to hold office and the right to vote.

THE SECRETARY: We have several associate members.

MR. JONES: In the event of a member not being a civic representative, if he leaves his official position and takes another position under a private corporation, is he still eligible to membership in the society?

THE PRESIDENT: I think if he severs his official connection with any municipality, why then he can only continue as an associate member, under the constitution.

MR. BENZENBERG: Except where he follows the profession of a consulting engineer, in which case he continues as a full member.

The amendment to article 6, section 4, was unanimously agreed to.

Thereupon the convention took a recess until 8 o'clock p. m.

EVENING SESSION.

The President called the convention to order at 8 o'clock p. m. and announced that the first paper would be that of Dr. Reynolds, of Chicago, entitled "Garbage Disposal," which was read by the Secretary as follows:

* * * * * * * *

(See Part II for Reports, Papers, etc.)

* * * * * * * *

THE PRESIDENT: The next report on the program is on "City Government and Legislation," by Mr. L. E. Farnham, City Engineer of Camden, N. J., Chairman of the committee. Mr. Farnham is not present. Are there any papers upon this subject? If not, the next business on the program will be the election of officers. I understand that the committees appointed yesterday are ready to report. The Secretary will read the report of the Committee on Nominations.

The Secretary read the following report of the Nominating Committee:

REPORT OF THE NOMINATING COMMITTEE.

WASHINGTON, D. C., OCTOBER 27TH, 1898.

TO THE MEMBERS OF THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.

GENTLEMEN:

Your Committee appointed to make nominations for officers of this society for the ensuing year desire to make the following recommendation:

President: Nelson P. Lewis, Brooklyn Borough, New York, N. Y.
First Vice-President: A. D. Thompson, Peoria, Ill.
Second Vice-President: R. H. Thomas, Parkersburg, W. Va.
Third Vice-President: B. H. Colby, St. Louis, Mo.
Secretary: D. L. Fulton, Allegheny, Pa.
Treasurer: John L. Kennedy, Nashville, Tenn.
Finance Committee: F. J. O'Brien, Oswego, N. Y.; F. A. Twamley, Grand Rapids, Mich.; Gilbert S. Vickery, Bangor, Me.

Respectfully submitted,
A. D. THOMPSON,
GEO. H. BENZENBERG,
AUGUST HERRMANN,
M. R. SHERRERD,
LANSING H. BEACH,
Committee.

THE PRESIDENT: Are there any other nominations by any members of the society?

On motion it was ordered that the report of the committee be adopted and that the Secretary cast the ballot for the persons therein named as officers for the ensuing year.

THE PRESIDENT: I take special pleasure in announcing the the election of Mr. N. P. Lewis as President of this society for the ensuing year, and I am sure we shall all be glad to hear from him. (Applause.)

MR. LEWIS: Mr. President and Gentlemen, I am certainly deeply sensible of the compliment which you have thus paid me and I only hope that I may do something during the coming year to merit the confidence that you have manifested in me.

I wish to take advantage of this opportunity to say a word or two as to the work of the coming year and the policy of the society. I want to say it more especially as a municipal engineer.

The engineer has been a good deal in evidence, perhaps, at this convention, and while I should be the last to deplore that fact, I am disappointed that the administrative officers of our American cities are not more fully represented.

The engineer needs not only the respect but the confidence and sympathy of the administrative officer. The engineer may design and carry out our public works, but those works have their inception in other departments, other bodies. The gentlemen who compose the committees of our legislative bodies and the administrative officers who shape the municipal policy should be certainly brought into closer contact with the engineers and I believe that a great benefit can be conferred by this organization not only upon municipal engineers but upon all municipal officers and upon the tax-paying public by bringing more closely together those who authorize and those who plan and carry out our public improvements, and I sincerely hope that at the next convention we shall have a more generous representation of officers who have been elected by the people. (Applause.) I believe that the influence of you who are here should be exerted during the coming year to try to induce a greater number of our growing, prosperous cities to be represented at the next convention. We do not look always to the larger and older cities of the Atlantic seaboard for the best way of doing things. I have been greatly impressed by the wide-awake spirit and disposition to take advantage of the best that has been offered, to take advantage of the costly experiments and unsatisfactory results frequently attained in the older cities, which has been manifested by our younger and more progressive sisters of the West and South. Their transportation facilities, we must admit, are vastly superior to those of the older cities. To be sure they have had the advantage of development and the experience of the traction companies in other parts of the country. The cars in western cities are handsomer, more commodious and the service is apt to be better, and I surely have learned a great deal from some of our sister cities of the West and Southwest.

I certainly hope that there will be a goodly representation of all branches of city government in these various cities at the next convention, especially the administrative officers.

I thank you once more for your kindness. (Applause.)

THE PRESIDENT: The First Vice-President is Mr. A. D. Thompson, City Engineer, of Peoria, Ill. We shall be glad to hear from him. (Applause.)

MR. THOMPSON: Gentlemen, I was not holding back from bashfulness, but I felt rather ashamed of myself because I was a member of the Nominating Committee. (Laughter.)

CAPTAIN BEACH: Mr. President, as one of the other members of the Nominating Committee I will state that he could not help himself.

MR. THOMPSON: I thank the convention and members for the honor that is thrust upon me and I shall certainly try to do my portion to make the organization a pronounced success. I feel that every meeting we have had has been more successful than the previous one and each one that I have attended has been well worthy of the time and money spent, if for no other reason than to come in contact with members from the different cities. Again I thank you. (Applause.)

THE PRESIDENT: The Second Vice-President chosen for the ensuing year is the Hon. R. H. Thomas, of Parkersburg, West Virginia. The convention will be glad to hear from Mr. Thomas.

MR. THOMAS: Gentlemen, this is an unexpected honor you have conferred upon me, and I thank you for the confidence you have shown in making me your Second Vice-President. I can only say that I will endeavor to the best of my ability to do all that there is to be done to further the interests of this association. I believe we are on the right track and advancing and there is no reason why we should not continue. (Applause.)

THE PRESIDENT: The Third Vice-President is Mr. C. H. Colby, of St. Louis, Missouri. We shall be glad to hear a word from Mr. Colby, if he is present. He has been with us all day, but seems to be away just now. Our Secretary, Mr. D. L. Fulton, has been chosen to fill the same responsible position again. We certainly could not spare him and I know you will all be glad to hear a word from him.

MR. FULTON: Gentlemen, members of this society, I certainly appreciate the honor that has been again conferred upon our city in electing me for the third time to be your secretary. I would like to say that there is some work in the coming year for the members of this society. It is very hard for one or two people to arouse the interest of the city officials of our different cities of this country, who have never been to our conventions. I have written a great many letters to gentlemen whose names I have secured, as being city officials in a great many of our larger cities, and I am sorry to say that the majority of those letters were not even answered. What I should like to say is this: our Executive Committee has by resolution which we have passed made it the work of the Executive Committee to parcel out the country, and each one take a part in soliciting members for the society. But even outside of the Executive Committee it seems to me that each individual member has a duty in this matter, and each one of our members should endeavor by all means to try to get his neighboring city officials interested in our society. If you will glance over the membership list you will be surprised to see the number of large cities that have not had any representative here. New York city has never had one, Boston has never had one, Philadelphia has never had one, and Pittsburg has never had one. Baltimore this year has one representative. New Orleans has never had one, and I could name a great number of others which are similarly situated. While I tried very hard to get the city officials of our neighboring city of Pittsburg to come, the council and all the city officials went to Philadelphia this week to the peace jubilee and of course they could not come here. I shall try again next year, and hope to have better success; but if each one of our members would make a special effort to get in all the people whom he knows or whom he knows by reputation to come here and join our society, that would be one of the best ways to advance the interests of the work. I feel satisfied that this organization is one of the very best that there is in existence which has these purposes in view. There is one notable thing in connection with this society. It seems to me that the work of the individual members is disinterested, for when a man ceases to be a city official then the information that he has gained is to a certain extent not valuable to him. It is only valuable to him while he is in office. I hope that all our members this year will help the President and all the officers to try and secure a better representation next year.

I thank you again for the honor which you have conferred. (Applause.)

THE PRESIDENT: Mr. John L. Kennedy, of Nashville, has been reëlected Treasurer. He was unavoidably kept from attendance at this convention, but he has been a very faithful treasurer and the association has done well to reëlect him. The chairman of the Finance Committee is Mr. F. J. O'Brien. Mr. O'Brien is present and the convention will be glad to hear from him.

MR. O'BRIEN: Mr. President and Gentlemen of the Society, I thank you for again putting me on the Finance Committee of this organization, and I hope my next report will be better than my last one as regards the finances of the society. If I have anything to do with finances at all I like to have some on hand to meet all the obligations we have to meet during the year, and do not like to have the President-elect loan the organization $100 or $150 and then wait until the end of the year to get it back. I think that this year we shall come out all right, because we have increased the dues to $5. I think just as the President-elect and the Secretary do, that other city officials besides engineers should come to this convention. I like to meet the engineers, because without them the convention would not amount to much, but we want the others as well. I know I tried to get some of my fellow officials at home to come here and see what is going on. If they would, I think when they got home, it would be easier to manage some of them because they would know what we are doing and trying to do. (Applause.)

THE PRESIDENT: Mr. F. A. Twamley, of Grand Rapids, Michigan, is also elected a member of the Finance Committee. We should be very glad to hear from him also. He does not seem to be present this evening, however. Mr. Gilbert A. Vickery, Civil Engineer, of Bangor, Maine, is the third member of the Finance Committee. We should be glad to hear from Mr. Vickery.

MR. VICKERY: Mr. President and Gentlemen, I thank you for the honor conferred upon me and promise to do my duty and to further the interests of the society as much as possible.

THE PRESIDENT: The next business will be the selection of the next place of meeting. The Secretary will read the report of the committee.

The Secretary read the following:

WASHINGTON, D. C., OCTOBER 27TH, 1898.

TO THE PRESIDENT AND MEMBERS OF THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS:

GENTLEMEN:

Your Committee appointed on the 26th inst. for the purpose of selecting a place of meeting for the year 1899 beg to report: That we have had under consideration letters of invitation from the Mayor of Niagara Falls, N. Y.; also from the Mayor of Detroit, Mich.; also resolution from the City Council of the city of Toronto, Canada, inviting the society to hold the convention of 1899 at their respective cities. After duly considering the invitations, we find that the city of Niagara Falls and the city of Detroit are not members of our Association. The Committee beg to recommend that the city of Toronto, Canada, be the next meeting place of this Association. Further, we beg to recommend that the Secretary be requested to notify the Mayors of the cities of Niagara Falls and Detroit and ask them to become members of the Society. All of which is respectfully submitted.

M. L. HOLMAN.
S. J. BROCKMAN.
CHAS. A. HERR.
N. P. LEWIS.
BERNARD SAUNDERS,
Chairman.

MR. O'BRIEN: I move that the report of the committee be adopted and that the society meet at Toronto next year.

The motion was carried.

MR. JONES: Mr. President and Gentlemen: On behalf of the Toronto representatives I beg to thank you most heartily for the decision of the convention to meet in Toronto in 1899. We have nothing very elaborate in our city to show you, but we will treat you as well as we possibly can, and I assure you that you will get all the comfort that it is possible for our city to bestow upon you, and I will assure you of a good Canadian welcome.

MR. SAUNDERS: Mr. President and Gentlemen, I did not know before that bashfulness was one of my virtues. I thought I could only attribute that to our worthy street commissioner. I thank the convention very heartily for adopting the report of the committee. It is well said that it is very difficult to go to a place and not find something to show to those who visit it. I have found very many things useful to me since I have had the pleasure of attending these conventions. It is a source of regret to myself, as I know it is to you, sir, to find that in this great city of Washington you have not more representatives of this society with you to help in giving views and exchanging opinions. I have strongly recommended the society to all our neighbors, and in asking you to come to Toronto I can assure you of a hearty welcome and that the committee who are here with me will do everything in their power to receive you as you should be received. I hope that our efforts will add to the number in attendance. (Applause.)

Mr. Campbell: Mr. President, I also come from the city of Toronto, although I am not a member of the delegation appointed by that municipality. I am, however, in the service of the government of the Province of Ontario which has its headquarters in the city of Toronto, and I am sure that the department to which I belong will do everything it possibly can to make your visit pleasing, entertaining and profitable while in the city of Toronto.

The city of Washington undoubtedly occupies a very unique position among the cities of the United States. You are unique in your location and you are favorably situated in having at your back a very large amount of money appropriated by the national government for the improvement of your city. You are also fortunate in having in this city an unique form of government, such a form of government as guarantees to people the most experienced men at the head of the various departments. Consequently we from Toronto have been very much pleased, indeed, in looking at what was to be seen here and to notice the wonderful improvements which have been made. Washington stands as a city which affords an object lesson in all manner of municipal improvements, for the different municipalities of the United States, as well as being the national capital, and it was largely for that reason that I felt like coming to your convention for the first time to listen to the problems which you attempt to solve, and the information which you have tried to disseminate. I have listened with a great deal of attention to papers which have been read and to your discussions, and I feel that I have profited very much indeed by them. I am quite surprised to find that your meeting is not more largely attended than it has been and I am somewhat surprised at the personnel of this meeting. As one gentleman has said, it appears to be composed largely of civil engineers. You have an association of engineers in the United States known as the American Society, one I suppose of the largest and strongest societies of its kind on the continent of America, and one which is formed for the purpose of advancing the interests and education of that particular profession known as civil engineering. So I do not think it is necessary for you to have another association known as an association of city engineers. I do think the object of this meeting is being lost sight of very largely and that only engineers are attending it, whilst this meeting should be attended by the executive officers of every municipality. Therefore, I think a strong effort should be put forth to secure as large a membership and turnout of the executive officers of every municipality as possible. I have had some experience in dealing with municipal councillors and with municipal officials, and I notice one thing which seems to be strikingly characteristic of all these municipal bodies, councillors as well as officials, and that is the amount of self-confidence which they possess in the opinions they have, and the lack of energy which they put forth in trying to secure information from others. I find that the city engineers who are taking a very great interest in their own work and making a success of their own business, who lay out important municipal work and carry it to a successful completion, are not only willing but anxious to give the details of that work for the benefit of their fellows and for the purpose of improving the similar projects in other cities. I also find that the cities and officials who are not anxious to give such information and assistance to others are cities and officials that are ashamed of the work they are doing. In almost every municipality in our country money is being taken out of the pockets of the rate payers by the cold machinery of taxation, for the laying out of streets, the building of sidewalks, pavements, sewers, water works, and things of that kind; which money, instead of being intelligently expended as it should be, is in too many instances poured into the mud by the careless hand of innocence and inexperience. (Applause.) But if it were possible to get our municipal officials and our public men to attend meetings of this description, where matters of this kind are gone into thoroughly by experienced men who are willing to give the results of their own personal experience, I think millions of dollars would be saved to the poor tax payers in every locality throughout the United States and Canada.

I will be very glad to assist as far as I can in making your meeting at Toronto profitable and pleasant while there and will in the meantime use my best efforts in securing as many of our municipal officials as possible to become members of this association and be present at your annual meeting next year in Toronto. (Applause.)

The President: There is another committee report on the program for this evening; that of the Committee on Municipal Data, of which Mr. Charles Carroll Brown, City Engineer, of Bloomington, Illinois, is Chairman.

* * * * * * * *

(See Part II for Reports, Papers, etc.)

* * * * * * * *

Adjournment was taken until Friday at 9:30 o'clock.

THIRD DAY.

FRIDAY, OCTOBER 28, 1898.—9:30 O'CLOCK A. M.

The convention was called to order by the President, who said:

The first report this morning is by the Committee on Municipal Franchises, of which Mr. Rosewater is Chairman. I have a letter from Mr. Rosewater in which he expresses regret at not being able to get here. Mr. Saunders, who is a member of that committee, is present .

Mr. Saunders: I was very much disappointed not to have heard from Mr. Rosewater nor from the other gentlemen who are members of the committee. Not hearing from them I brought down some data, thinking they might have their report in skeleton form and that I could help to fill it out. I am sorry to find that neither of them are here and that there is no paper. We will take care that there is one next year.

The President: I think the convention would be glad to receive any information from you upon the subject.

Mr. Saunders: I will hand it to the Secretary. I have it in my room.

The President: Mr. Rosewater in his letter says:

"It is with considerable regret that I am compelled to report my inability to attend the convention this year and especially that I have been unable, owing to the pressure of business, to prepare an article on municipal franchises, which I had hoped under any circumstances to be able to submit."

The next committee report is on "Coating of Cast Iron and Steel Riveted Pipes," by L. W. Rundlett, City Engineer, of St. Paul, Minnesota, who is the Chairman of the committee. I believe Mr. Benzenberg has a paper prepared by the Chairman on that subject, which he will read.

Mr. Benzenberg read Mr. Rundlett's paper as follows:

* * * * * * * *

(See Part II for Reports, Papers, etc.)

* * * * * * * *

Mr. Bouton: Mr. President and Gentlemen: Apropos to the review just read and in connection with it I should like to call attention to a necessity which I believe exists, for the expansion of the society. I am free to say that up to four days ago I had no knowledge of the existence of such a society and no knowledge of the purpose of it. It seems to me that before we adjourn it would be well to have a committee appointed, if there is not one already in existence for that purpose, to bring to the knowledge of the various municipalities the fact that a society such as this exists for the betterment of municipalities. I think it will appeal more strongly to the various city governments throughout the United States if the Mayors of the various cities which are represented here to-day will call the attention of the officials of sister municipalities in their States to the fact that this organization exists and that its main purpose is for the betterment of the municipality and not for the betterment of individuals. I am free, sir, to say that being a pretty busy man and my desk being littered with communications, that if I had received a communication from this society I should probably have thrown it in the waste-basket in the belief that it had emanated from one of the many concerns which have something (more or less valuable) to dispose of, but if I received a letter from the Mayor of a neighboring city I should give attention to it, and if that Mayor appealed to me, not only to help my municipality but other municipalities, it would influence me greatly.

I believe, if such a plan were adopted our meetings would be greatly enlarged and our convention would show an appreciably greater attendance than is seen to-day.

I also believe that if we had a few more laymen as representatives, a few more executive officers who are not engineers, it would be productive of much good. While I am free to admit that the interchange of opinion among engineers is something which adds largely to the betterment of municipalities, there is yet the individual who takes the ideas of the engineer, sees that they are carried out, and looks to the financial part of the transaction. We have not heard from these people at all. I have sat here and listened to papers and discussions about electrolysis, the reduction of garbage and all manner of other things, the reading of which papers and the consequent discussion thereon must prove of incalculable benefit, but there are various other matters in municipal government which appeal very strongly to the non-engineering executive official, on whom devolve duties of scarcely less importance, and I wish a little more attention could be given to that side of the question. I may not voice the views of a majority of those present, but I really do think that we should take cognizance of all those matters which tend to build up and to protect a municipality.

Although I know that the hour is getting late there are a couple of other matters that I should like to refer to. In our own city we have found that in the matter of contracts, individual bondsmen have not been a success. Therefore we have endeavored to get the various people who bid for work to secure one of the various surety companies to go on their bonds. In fact, we have passed a resolution to that effect, making it a requirement that bonds should be given by a surety company or that a certified check should be presented, which check should be held until the time of the completion of the work and the necessary lapse thereafter before the final payment is made.

Another matter to which I would like to call attention and one quite in line with the subject of which I have been speaking is the percentage system of bidding on contract work. In the city of Jersey City we have been troubled greatly in the past by the persistence of contractors in submitting unbalanced bids. Our rules prohibited this class of bidding, but the line was hard to draw and contractors were both argumentative and resistant. We have finally resolved upon a plan which I think hits the nail squarely on the head. It has been successfully tried in our city during the year last past and not a complaint has been thus far heard.

The general custom heretofore has been for the engineer to prepare an estimate of quantities which were advertised, and on the basis of which bids were submitted by contractors. For instance:

About 100 cu. yds. of earth excavation, per cu. yd.—
" 15 " " " rock " " " " —
" 115 " " " earth filling, " " " —

And so on, ad libitum. The contractor would put a price against each item, such price representing what he expected to be paid per yard for each yard found in the process of doing the work. He oftentimes made it a gamble, and where a low estimate had been made by the engineer the contractor would put a price largely excessive, this being followed by a price ridiculously low on some other item, so that the average of bid was maintained. While this resulted many times in the contractor getting his fingers burned, there were more than a few cases in which the engineer's estimate was largely exceeded and immense profits made. When the contractor got the worst of it he generally endeavored to excite the sympathies of the executive officers and secure an allowance for extra work of some kind. When the city got the worst of it the contractor could laugh in his sleeve, but the people along the line of the improvement and against whom an assessment was levied, would be up in arms. It was a most unsatisfactory arrangement all around and a cure seemed almost impossible of accomplishment, but we have finally succeeded in adopting what seems to be a specific.

Our present plan requires that the engineer shall submit with his estimate of quantities, a price for each item based on current rates and existing conditions. These prices we designate the Hundred-Per-Cent-Standard and they are advertised with the estimate. The contractor is required to state at what percentage of the hundred per cent. standard he will do the work. He may want more than one hundred per cent. estimated by the engineer, he may be willing to do the work for less, but the per cent. he quotes applies to every item named in the estimate and it matters not to the city whether, in the actual doing of the work, the estimate over-runs or under-runs, no more than a fair price can be paid.

I submit this for the benefit of the society and (when it has been examined for weak points, of which I believe it has none) cannot too strongly recommend its general adoption.

In closing I suggest that some action be taken whereby executive officers may be induced to submit reports or read papers, or send them here to be read. I should in the future like to hear from them more largely, while in the matter of the enlargement of the association I believe that the course which I have suggested will result in a greatly increased attendance.

MR. McLAUGHLIN: I thoroughly agree with Mr. Bouton in what he has said. While of course it is a very good thing to have the engineers of the different cities here, to tell us of the work which has been done, from their side of the question, I feel that it is the duty of this society to see that the mayor of every municipality in this great country of ours is notified and requested to insist upon having the representative heads of the various departments become members of this society. When the engineers in different cities submit their plans for the different kinds of improvements to the various boards of works and heads of departments, while it has taken the engineer probably months to perfect his plans, yet it remains with the layman who represents the executive department of the city to decide whether that work is important or not, and if these laymen do not have the knowledge that is required to go ahead with these improvements, all the time and labor expended by the engineers will go for naught. Then they say: "Oh, well, that is all right, but we cannot see it in that way;" whereas, if they were here, and had interchanged views with the different engineers and the different men who represent the different municipalities, I am satisfied that they would go back home with broader views and clearer conceptions of the general subject of municipal improvements; they would hear the papers that are read and the general discussion that takes place and be in a position to sit down with their engineer and go into a discussion of the ways and wherefores of different improvements which may come before them, and I feel that it is the duty of every man who is in power at all in any municipality to urge upon the heads of the different departments who have control of all municipal improvements to insist that some of their number shall visit the meetings of this convention and become members of this society. I am satisfied that our Mayor, Mr. Seymour, who is with us here from Newark, as well as every member of the board of works and the different gentlemen who have come here are very much impressed with the great importance and material benefit that Newark will derive from their attendance upon conventions of this kind. I feel as the gentleman from Jersey City and the gentleman from Toronto very ably expressed themselves yesterday, that the more members of the laity we have with the engineers, the better it will be for all concerned. When we come here the city engineer is supposed to come with us, and I believe that if the proper authorities would come here with their engineers, then, when they went back home, and any improvement is spoken of or is going on in their city, the engineer could feel that he was not the only man who knew something about the work, but that the men who are going to authorize the work are in close touch with him. Such a course cannot fail to be of benefit to citizens and property owners of the municipality which they represent. (Applause.)

THE PRESIDENT: The Mayor of the City of Newark, N. J., Mr. Seymour, is with us. I think if he would say a word the convention would be glad to hear him.

MR. SEYMOUR: Mr. President, when I came here I did not suppose for a moment that I should be called upon to say anything. To me this convention is not unlike a pitcher. It has been full to overflowing and now it is getting down to where it is almost empty. I wish to say that I have taken in a good portion of its contents and I shall go back to Newark feeling that this has been a good work and that the money which has been expended for the purpose will certainly be of great value to our city and to other cities; and after being here and taking in all this matter I am really surprised to think that we who are supposed to encourage these matters are so far behind. I fully agree with our friend from Jersey City, that if we wish to increase the benefit which is bound to come from such meetings, every means should be taken to secure the attendance of those who are concerned in the planning and carrying out of municipal improvements.

Of course there are many things that could be talked about but the time is getting late and I can only say, gentlemen, that I am very grateful to those who urged upon me the necessity of coming and hearing and seeing for myself. And I wish to say that if the Mayors of cities would only come here, I think instead of those who have an interest in our affairs holding back and considering the question of the expense of coming, they would find that there is much to be derived from it. I think the suggestion is a good one that those here present should undertake to secure the attendance of city officials in their various cities and states. If that is done I think you will have a convention which you may well be proud of.

THE PRESIDENT: Mayor Thomas, of Parkersburg, West Virginia, is also with us and although we have had the pleasure of hearing from him two or three times we should be glad to hear a few words from him.

MR. THOMAS: I was just going to say that I hope there will be an effort made to have a large attendance here of the officials of our smaller towns. I think they need the knowledge which they can gain here at the meetings of this society, and that their attendance would be beneficial to every town represented. We have several small towns in our State whose officials I know and I shall make an effort to get the Mayors to send their officers here. The engineers of our towns should be sent here by the city authorities. I think it is more important for them to be here than for the Mayors to be here. The term of a Mayor of a city or town is generally one or two years. They are put in politically, but a civil engineer is educated and if he is out of office in one town he is in another or in private employment, and he is the man who knows better what to do. Mayors' terms are generally very short, and when a man goes out of the Mayor's office he is not apt to be interested in any of these meetings; but the responsible heads of departments of even the smallest towns ought to be represented here at these meetings and I shall try to get our smaller towns represented. (Applause.)

MR. BROCKMAN: Mr. President, before the meeting closes I wish to offer a resolution which I ask the Secretary to read.

The Secretary read as follows:

Resolved, That we express our thanks to the Commissioners and members of the District offices and the citizens of the District, for the courtesies and hospitality shown during the fifth annual convention of this Society in this city; and that we also extend our thanks to the Washington press, for the extended notices of our proceedings; to Hon. John B. Wight, President of the Board of Commissioners, for his cordial welcome and to the various street railway companies for the courtesies extended and kindness shown.

The resolution was unanimously adopted.

MR. BENZENBERG: Mr. President, on Tuesday evening, those of us who were here had the opportunity for a few moments to shake hands with and greet one whom we have all either known personally or known of by reputation, a gentleman whose interests and sympathies have been with this association from its very inception, who has done very much to interest and increase the attendance from his section of this continent. Just as he had registered and had been assigned to his room a telegram was received which notified him of the death of his most promising son, who had lost his life in Africa by the bullet of a native while they were returning from an expedition up the river. This necessitated his immediate return to Toronto to break the news to his family. Many of us have during the past summer witnessed the bereavement and the grief that came to those who received similar news from the South during our war with Spain. We can therefore faintly imagine the grief that must have come to the heart of that father when he learned of the death of his son who was a lieutenant in the English army. It seems to me that it is no more than fitting that this association should express in a few words their sympathy and extend the same to him who would have been with us and whom we last year delighted to honor by electing him as Second Vice-President of this association. I therefore offer the following resolution:

Resolved, That the sympathy of the American Society of Municipal Improvements be, and is hereby, extended to Edward H. Keating, C. E., of Toronto, Canada, Second Vice-President of this Society, and his family in their sad bereavement, occasioned by the death of their son, Lieutenant Keating, of the Leinster regiment, British army, who was killed while in active service in Africa; and that the Secretary of this Society be instructed to transmit to our worthy Second Vice-President a certified copy of this resolution.

The resolution was unanimously adopted.

MR. O'BRIEN: I offer the following resolution:

Resolved, That the officers of the society be directed to prepare vouchers upon the treasury, providing for the payment of the liabilities of the Association in the following order:

1. A voucher in favor of Harrison Van Duyne, President, in the amount of $100, for money advanced to the Society during the past year.

2. A voucher in favor of D. L. Fulton, in the amount of $100, for services rendered as Secretary during the year 1897.

3. A voucher to cover all miscellaneous bills now due, as well as the incidental expenses of this convention.

4. A voucher in favor of the official stenographer (the amount of the same being at this time unknown), for the payment of the expenses of reporting and transcribing the proceedings of the convention.

And be it furthed resolved, That after these payments have been made, the Executive Committee shall be directed to take up and consider the question of printing the annual report and the expense pertaining thereto.

The resolution was unanimously adopted.

Mr. Lewis: Mr. President, I want to say a word as to the work of the coming year. Looking over the list of the standing committees appointed a year ago it will be seen that there are nine committees, of three members each, a total of twenty-seven. Of these committees two are unrepresented entirely, two are represented by two members each and five by one member each. Nine out of the twenty-seven have attended the convention. This is not as it should be. It has been customary in the past for the President-elect to announce the membership of the committees for the ensuing year before the close of the convention. I find, however, nothing in the constitution requiring it, nor do I find in the minutes of last year that any action of approval was taken as to the assignments announced by the President. I spent several hours last night wrestling with this problem of committee assignments, but inasmuch as there are many names on our list of members from whom no word has been received, and who have paid no dues, and whose status during the coming year is therefore uncertain, I thought it would be unjust to myself and to the committees which might be appointed and unjust to the society at large to be compelled to announce these committees at this time, or until I can communicate with absent members and receive from them a positive assurance that their committee will not be unrepresented in Toronto next year as has been the case at this convention.

I therefore ask you to allow me to defer the announcement of the committees until I can have a reasonable time to communicate with members of the society who are not here and to consult the preferences of the members as to committee service. I feel confident that you will see the justice of that request and accede to it. (Applause.)

THE PRESIDENT: I do not think it is necessary for the convention to take any affirmative action on the statement of the President-elect. I think the matter is entirely in his hands.

MR. HEWSON: Before we adjourn I certainly should like to see some steps taken on the suggestion of the gentleman from Jersey City that each representative here will pledge himself to call the attention of municipal officers in his State to this society, its objects and the importance of its work, and to induce the various municipal officers to attend the convention next year if possible. If that action is taken we shall certainly receive a wonderful impetus. I know personally that with a very little effort the representation here to-day has been increased by a number of municipalities near the City of Newark, by interesting the executive head of the city in the importance of the work. In most instances it was entirely unknown to them, but on a statement of the case they became interested at once, and the result is that we have received several additions to our membership because of that effort. If in each State members will take a similar course, either by a committee appointed or by the voluntary action of members, we can achieve very substantial results in this respect in the future.

THE PRESIDENT: I think it is fair to state that the Executive Committee of the society felt the same way, and with that object in view an amendment was added to the constitution making it somewhat more the duty of the Executive Committee to endeavor to see that important cities were represented. Of course it is in the hands of the convention to take any further action that they may see fit.

Mr. Hewson: With that explanation, I am satisfied that the matter can well rest with the Executive Committee. I did not know that that amendment had been adopted.

Mr. Benzenberg: I should like to offer the following resolution:

Resolved, That the thanks of the society and the convention be extended to all the outgoing officers and to the members of the various committees, for the very able and pleasing manner in which they have performed the duties which were imposed upon them one year ago.

Mr. Lewis: Mr. President, in seconding this resolution I wish to express my appreciation of the very high class of papers which have been presented to this convention. I think I am safe in saying that most of the papers would have been considered creditable if read before any of the technical societies which we have in this country. I do not believe that quite so high a class of papers has been reached in the history of this society before as those which have been presented here this year. They will be extremely valuable when printed, and I think they will go a long way toward impressing upon the public at large the importance of the society.

The President: On behalf of the officers and the committees I am sure I can say that it has been a labor of love as well as a duty which they have tried to perform, in their efforts to have a successful convention. Of course, every convention depends for its success more largely after all upon the work of individual members, in the preparation of papers and in the study of the various questions which come up, and that is what we hope to secure more fully in the future.

Mr. Benzenberg's motion was agreed to.

And then on motion the convention adjourned to allow its members to attend a reception and pay their respects to President McKinley at the White House, and afterwards to take a trip on the Potomac to Mount Vernon.

PART II.

REPORTS OF STANDING AND SPECIAL COMMITTEES

MISCELLANEOUS PAPERS, &C.

AND DISCUSSIONS THEREON

CORRECTION.

Since the paper on "Rates of Taxation in the larger Cities of the United States" was printed, corrections have been made by Mr. Fulton, of Allegheny, Pa., and Mr. Fisher, of Rochester, N. Y., as follows:

Pittsburg, Pa., and Allegheny, Pa.

"The tax rate of Pittsburg, Pa., is stated at $23.65 per $1,000. This should be changed to $21.41 per thousand. The tax rate of Allegheny, Pa., is stated at $24.95 per thousand; this should be changed to $20.65 per thousand. There was a state tax of four mills reported originally, but it appears that this is a tax on personal bonds and mortgages only, and not a tax on real estate.

"This correction will change figures shown with reference to these cities on pages 6, 9, 11, 12 and 15 of the paper as submitted."

Rochester, N. Y.

"The figures given for Rochester, N. Y., for street cleaning, removal of ashes and garbage, in the paper, are $246,000. This should be changed to $186,000. This changes the per capita cost for that city from $1.41 to $1.06. This table is shown on page 19."

RATES OF TAXATION IN THE LARGER CITIES OF THE UNITED STATES.

By AUG. HERRMANN,
Commissioner of Waterworks, Cincinnati, O.

SUBMITTED TO THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS, AT ITS FIFTH ANNUAL CONVENTION, WASHINGTON, D. C., OCTOBER 26, 1898.

GENTLEMEN:

In my annual address as the president of this society at its last annual meeting I suggested that the Committee on Taxation and Assessment, to be appointed for the ensuing year, take up and submit a report at the next meeting of the society, showing the rates of taxation throughout the leading cities of the country —this report to show, among other things, the total assessable valuation of property for taxation (both real and personal), the percentage of value of real estate as returned for taxation in the various cities, the tax rate in each city, as well as a division thereof, showing separately the rate for municipal, county, state, educational, sinking fund and interest, special, and all other purposes that go to make up the grand total. Such a report, it seemed to me, would be of incalculable benefit to the members of the society, and would materially aid us at all times in making intelligent comparisons of the tax rates of our respective cities with those of other cities to be presented in a report of this kind.

Having been appointed chairman of such Committee on Taxation and Assessment, I followed out the suggestion as outlined above, and now submit for your consideration my report on this subject.

In order that this report might be confined to the larger cities of the United States, I determined to take into consideration only such cities as had a population of 80,000 or more at the last United States census, excepting therefrom the city of Washington, D. C., alone, and this for the reason that the laws and conditions governing its management were so different from those of other cities that in my judgment an intelligent comparison could not be made.

A list of questions was prepared and printed, and sent out by me to such members of our society as represented cities of that class; and in those cities of that class that have not as yet acquired a membership in our society, such lists were sent direct to the Mayor or proper officials thereof, with the request that the information sought be furnished as accurately as possible. In almost every instance prompt replies were received. It was at once seen that very few cities in the country have exactly the same system; and this fact necessitated repeated inquiries in a number of cases in order that a report could be formulated on an equal basis in all of the cities.

The data desired was for the year 1898. New York and Brooklyn having been merged into Greater New York, the information could not be obtained, as no accurate or even approximate figures would be furnished until the close of the year.

Statistics have been obtained and tabulated from all of the remaining cities of this class, excepting the cities of Syracuse, N. Y., and Worcester, Mass., twenty-nine in all. Some of them are not as complete as they could be; in such cases approximate figures are used.

The list of questions that was sent out was as follows:

1. Name of city and population, January 1, 1898.

2. What is the total valuation for taxable purposes, giving real estate and personal property separately?

3. What is the tax rate per $1,000? (This to include state, county, municipal, educational, sinking fund and interest, and all other purposes, excepting maintenance of waterworks.)

4. How is this total made up, classified under the following headings: State Levy, County Levy, Municipal Levy, Educational Levy, Sinking Fund and Interest Levy, Special Levies? (A number of cities do not make separate levies under these headings, and in order to make comparisons approximate figures were obtained in these cities, taking the entire levy as a basis.)

5. At what per cent of its true value is real estate assessed for taxable purposes?

6. What sources of income, if any, have you, exclusive of taxation, that are applied for the maintenance of municipal or other departments, not including waterworks receipts? (This to be given under the following headings: Earnings and Unexpended Balances, Liquor License, including tobacco, etc., Street-railroad Licenses and Fees, General Licenses, Vehicle Licenses, Fines, Fees, Costs, and all other miscellaneous items.)

7. In what manner is this income distributed? To what funds is it credited?

8. What is the rate in 1898 for the following purposes? (Taxes only for these purposes: Police Fund, Light Fund, Fire Fund, Street-cleaning Fund, and Education.)

9. What is the appropriation or estimated expenditure for these same purposes in 1898? (This is to include taxes and all other sources of income.)

10. What was the bonded indebtedness on January 1, 1898? (Giving same under various headings, such as School Purposes, Public Buildings, Parks, Sewerage, Improvements, Funding and Refunding Debt, Waterworks, and other miscellaneous items, and deducting therefrom bonds purchased and held as sinking fund and cash on hand, thus showing the net bonded debt January 1, 1898.)

11. In the total tax rate as given is any thing included for the improvement of streets, sewers, sidewalks, etc., and if not, how are improvements of this kind provided for?

12. Are taxpayers subject to any other assessments than the taxes and licenses herein referred to, excepting water rents? If so, explain fully.

13 and 14. Have you a printed tax-levy ordinance showing details, etc., or any other information on this subject?

The answers to these questions applying to the city of Cincinnati were sent out with the blanks as a guide.

All the information was to be for the year 1898, and where exact figures could not be secured, estimated receipts or approximate expenditures were obtained.

All of this information has been tabulated, and is hereto attached, marked Exhibit "A." It is impossible for me at this time to discuss this matter in detail or to present the entire tabulation to you, the table covering a sheet 9 feet by 3 feet.

I will, however, present certain deductions made by me from the information obtained, which may be of interest to you at this time, and would recommend that the Executive Committee be directed to print the table as an entirety in the annual report, and I earnestly commend the same for your careful consideration and analysis.

The first table that I will present is the total tax rate for these various cities in the year 1898, this including, as is indicated by question 4 already referred to, the state, county, municipal, educational, sinking fund and interest, and other special levies which go to make up the grand total, as follows:

Cities.	Rate per $1,000.	Cities.	Rate per $1,000.
Chicago, Ill.	$96 50	Pittsburg, Pa.	$23 65
Omaha, Neb.	47 12	Buffalo, N. Y.	23 54
Toledo, O.	33 20	Milwaukee, Wis.	23 12
Denver, Col.	31 00	†St. Paul, Minn.	21 40
Cleveland, O	29 30	Newark, N. J.	21 00
Jersey City, N. J.	28 90	Rochester, N. Y.	20 73
New Orleans, La.	27 00	St. Louis, Mo., max.	20 50
*Columbus, O.	27 00	St. Louis, Mo., min.	16 70
Kansas City, Mo.	26 24	Albany, N. Y.	20 00
Cincinnati, O.	26 18	Detroit, Mich.	19 23
Minneapolis, Minn.	25 00	Philadelphia, Pa.	18 50
Allegheny, Pa.	24 95	Indianapolis, Ind.	17 30
Nashville, Tenn.	24 50	San Francisco, Cal.	16 95
Baltimore, Md.	24 37	‡Providence, R. I.	16 50
Louisville, Ky.	23 65	Boston, Mass	13 50

---

*Does not include street-cleaning. †Does not include removal of ashes.
‡Does not include removal of ashes and garbage.

At the first glance at these figures one can hardly believe that there could be such a wide diversity in the rates of taxation in the larger cities of the country as the above would indicate; but the truth of the matter is that when analyzed there is no such divergence. In the first place, in making comparisons, the answers submitted to question 5 referred to — the question being "*At what per cent of its true value is real estate returned for taxable purposes in these cities?*"—must be taken into consideration. This is the key to the entire situation. In this connection I quote from my annual address a year ago on this point as follows:

> "It is a very easy matter to say that the rate of taxation in one city is twenty-five dollars on each thousand dollars' worth of taxable property, while in another it is only twenty dollars, and thereby create unfavorable comment; but when the subject is analyzed, and it is found that in the first instance taxable property is assessed at fifty per cent of its value, and in the latter at seventy-five per cent of its value, it can as easily be shown that the twenty-dollar rate, under those conditions, is higher than the twenty-five dollar rate."

This covers the matter in a nutshell. While the figures above apparently show that the tax rate of the city of Chicago is the highest in the country, being four and even five times greater than some of the cities above shown, the fact is that in reality they have one of the lowest tax rates in the country. This is explained by the fact that in Chicago real estate is returned at 11 per cent of its true value, while in the other cities referred to it runs up from 35 per cent in the city of Cleveland, O., to 100 per cent in the cities of Boston, Pittsburg, Allegheny, Newark, Minneapolis, Jersey City, and Providence.

As an illustration on this line: The tax rate in Chicago is $96.50 per $1,000, but real estate is returned at 11 per cent of its true value; while in Providence the rate is $16.50 per $1,000, and real estate is returned at 100 per cent of its true value. Thus, if a person had a piece of real estate in Chicago the true value of which was $10,000, it would be returned for taxation at 11 per cent of its value, viz., $1,100, and assessed at the rate of $96.50 per $1,000, which would make the taxes for this property $106.15 per annum; while in the city of Providence, with a tax rate of $16.50 per $1,000 as against $96.50 in Chicago, this same property, the true value of which was $10,000, would be returned for taxation at 100 per cent of its value—viz., $10,000—and assessed at the rate of $16.50 per $1,000, which would make the taxes for this property in that city $165 per annum, or $58.85 per annum more than in Chicago with its $96.50 rate.

In order, therefore, that this matter may be considered intelligently, I have prepared three tables, which I present for your consideration, as follows:

(*a*) The tax rates of these cities on a uniform valuation, representing real estate on a basis of 75 per cent of its true value, leaving the personal property remain as returned.

(*b*) The tax rate of these cities on a uniform valuation, representing real estate on a basis of 75 per cent of its true value, exclusive of moneys required for state and county purposes.

(*c*) The tax rates of these cities on a uniform valuation, representing real estate on a basis of 75 per cent of its true value, exclusive of moneys required for state and county purposes, and interest and sinking fund purposes; this table showing rate on a a uniform basis for municipal purposes only.

Table "A" is produced by taking the present valuations and the tax rate as fixed and ascertaining first the amount of money to be produced on such a valuation at the rate as fixed; then the valuation is increased or decreased as the case may be, so that real estate, instead of being returned at the various values now in vogue, is assessed on a uniform basis of 75 per cent of its true value, and the rate ascertained to produce the same amount of money on the revised valuation, the result of this being as follows:

NAME OF CITY	Present Taxable Valuation	Total Tax Rate per $1,000	Percentage of true value of Real Estate	Amount produced	Valuation on a uniform basis of 75 per cent of the true value of Real Estate	Rate necessary per $1,000 to produce same amount of money
*St. Paul, Minn....	$93,000,000	$21.40	40	$1,990,200	$161,687,500	$12.31
Kansas City, Mo...	67,750,000	26.24	40	1,777,760	113,250,000	15.70
Cleveland, O.......	141,915,430	29.30	35	4,158,122	263,919,535	15.76
† St. Louis, Mo....	353,988,510	20.50 16.70	60 to 66⅔	6,584,186	409,821,885	16.07
Indianapolis, Ind...	121,000,470	17.30	70	2,093,308	126,819.078	16.51
San Francisco, Cal.	351,784,094	16.95	75	5,962,740	351,784,094	16.95
Boston, Mass.......	1,036,063,094	13.60	100	14,090,458	828,514,369	17.01
Chicago, Ill.........	232,026,610	96.50	11	22,390,567	1,306,254,420	17.14
Detroit, Mich......	207,636,860	19.23	65 to 70	3,992,856	226,424,333	17.63
Philadelphia, Pa...	864,516,035	18.50	75	15,993,546	864,516,035	18.50
‡ Columbus, O.....	62,685,080	27 00	50	1,692,497	87,515,745	19.34
Newark, N. J.	138,373,305	21.00	70	2,905,839	146,271,469	19 87
Milwaukee, Wis....	144,683,425	23.12	65	3,345,080	163,322,824	20.48
§ Providence, R. I..	181,558,120	16.50	100	2,995,709	145,875,570	20.54
Denver, Col..	73,101,485	31.00	50	2,266,146	109,652,227	20.67
Cincinnati, O......	196,677,104	26.18	58	5,149,006	244,006,522	21.10
Rochester, N. Y...	112,792,990	20.73	80	2,338,198	106,424,411	21.97
Buffalo, N. Y......	245,674,630	23.54	70	5,783,180	262,133,595	22.06
Omaha, Neb......	33,049,503	47.125	33⅓	1,557,457	67,330,082	23.13
Albany, N. Y......	68,276,895	20.00	90	1,365,537	58,482,120	23.35
Louisville, Ky.....	118,800,000	23.65	75	2,809,620	118,800,000	23.65
Toledo, O.........	50,500,000	33.20	50	1,676,600	69,500,000	24.12
Baltimore, Md.....	362,122,738	24.375	75	8,826,741	362,122,738	24.375
Nashville, Tenn....	35,399,390	24.50	75	867,285	35,399.390	24.50
New Orleans, La...	139,199,913	27.00	90	3,758,397	122,147,228	30.77
Pittsburg, Pa......	267,764,072	23.65	100	6,332,620	201,298,625	31.46
Minneapolis, Minn.	109,654,337	25.00	100	2,741,358	86,705,851	31.62
Allegheny, Pa.....	75,500,000	24.95	100	1,883,725	56,625,000	33.27
Jersey City, N. J...	89,962,761	28.90	100	2,599,923	69,358,956	37.49

* Does not include removal of ashes.

† St. Louis maximum rate $20.50; minimum rate $16.70.

‡ Does not include cleaning of streets.

§ Does not include removal of ashes and garbage.

From this table it will be seen that for all purposes combined, and on assessable valuation arranged on a uniform basis, St. Paul, Minn., has the lowest tax rate of all the cities enumerated, viz., $12.31 per $1,000, while Jersey City has the highest rate, viz., $37.49.

Table "B" is produced by taking the present assessable valuation and the tax rate as fixed for state and county purposes, and ascertaining first the amount of money to be produced on such an assessable valuation for such purpose at the rates as fixed, and then taking the assessable valuation on a uniform basis of appraising real estate at 75 per cent of its true value, and determining the rate required on such a valuation to produce the same amount of money, and then deducting that rate from the total rate as shown in Table "A," thereby giving the total rate for all purposes, exclusive of state and county purposes, on a uniform basis of valuation. The result of this is as follows:

NAME OF CITY.	Amount of money to be produced for State and County purposes......	Rate required per $1,000 to produce same money. Basis of calculation valuation on a uniform basis of assessing real estate at 75 per cent of its true value........	Total tax rate, exclusive of State and County purposes, for $1,000, on a uniform valuation...
*St. Paul, Minn....................	$399,900	$2 47	$9 84
Indianapolis, Ind................	746,210	5 89	10 62
Omaha, Neb.....................	764,269	11 35	11 78
†San Francisco, Cal...............	1,794,099	5 10	11 85
Cleveland, O......................	1,007,600	3 82	11 94
Kansas City, Mo..................	422,760	3 73	11 97
Denver, Col.......................	884,528	8 07	12 60
‡Columbus, O....................	544,733	6 22	13 12
Newark, N. J......................	899,426	6 15	13 72
St. Louis, Mo.....................	884,971	2 16	13 91
Chicago, Ill.......................	3.341,183	2 56	14 58
Detroit, Mich.....................	672,743	2 97	14 66
Nashville, Tenn.	336,294	9 50	15 00
Boston, Mass....................	1,657,701	2 00	15 01
Milwaukee, Wis................	870,994	5 33	15 15
Cincinnati, O......................	1,268,567	5 20	15 90
Rochester, N. Y...................	545,015	5 12	16 85
Buffalo, N. Y.......................	1,169,411	4 46	17 60
Toledo, O..........................	439,350	6 32	17 80
§Providence, R. I.	326,805	2 24	18 30
Louisville, Ky....................	623,700	5 25	18 40
Philadelphia, Pa..................	No separate	rate.	18 50
Albany, N. Y.......................	277,886	4 75	18 60
Baltimore, Md....................	678,980	1 37	22 50
New Orleans, La..................	974,399	7 98	22 79
Minneapolis, Minn...............	734,684	8 47	23 15
Pittsburg, Pa..................	1,606,584	7 98	23 48
Allegheny, Pa.....................	453,000	8 00	25 27
Jersey City, N. J.................	768,282	11 08	26 41

* Does not include removal of ashes.
‡ Does not include street-cleaning.
† Includes county.
§ Does not include removal of ashes and garbage.

From this table it will be seen that for all purposes combined, exclusive of state and county levies, based on a valuation arranged on a uniform basis, St. Paul, Minn., has the lowest tax rate of all the cities enumerated, viz., $9.84 per $1,000, while Jersey City has the highest rate, viz., $26.41.

Table "C" is produced by taking the present assessable valuation and the tax rate as fixed for sinking fund and interest purposes, and ascertaining first the amount of money to be produced on such a valuation for such purpose at the rates as fixed, and then taking the valuation on a uniform basis of assessing real estate at 75 per cent of its true value, and determining the rate required on such a valuation to produce the same amount of money, and then deducting that rate from the total rate as shown in Table "B," thereby giving the total rate for municipal purposes only on a uniform basis of valuation. This rate is the one over which municipal officers have control, and, as shown, does not include taxes for state, county, and sinking fund and interest purposes. The result of this is as follows:

NAME OF CITY.	Amount of money produced in 1898 for bonded indebtedness, including interest.	Rate necessary to produce same on a uniform basis of assessing real estate at 75 per cent of its true value...	Actual tax rate for all municipal purposes, including education, on a 75 per cent basis. This is exclusive of State, County, and Sinking Fund and Interest purposes
Indianapolis, Ind.	$508,201	$4 00	$6 62
Nashville, Tenn.	230,096	6 50	8 50
*St. Paul, Minn.	307,365	1 28	8 56
†Columbus, O.	297,127	3 39	9 73
Boston, Mass.	4,268,579	5 14	9 87
Omaha, Neb.	109,063	1 62	10 16
Cleveland, O.	411,554	1 55	10 39
St. Louis, Mo.	1,415,954	3 45	10 46
Denver, Col.	219,304	2 00	10 60
Kansas City, Mo.	135,500	1 18	10 79
‡Providence, R. I.	1,034,881	7 09	11 21
§Philadelphia, Pa.	6,038,063	7 10	11 40
Newark, N. J.	354,235	2 42	11 40
§San Francisco, Cal.	59,803	47	11 68
Cincinnati, O.	1,003,053	4 15	11 75
Toledo, O.	391,375	5 63	12 17
Milwaukee, Wis.	431,709	2 64	12 51
Chicago, Ill.	1,531,375	1 15	13 41
Detroit, Mich.	195,178	86	13 80
Rochester, N. Y.	313,564	2 94	13 91
Albany, N. Y.	273,218	4 67	13 93
Buffalo, N. Y.	393,079	1 50	16 10
Louisville, Ky.	237,600	2 00	16 40
Pittsburg, Pa.	1,338,820	6 64	16 84
Baltimore, Md.	2,018,834	5 57½	16 93
Allegheny, Pa.	419,025	7 40	17 87
Minneapolis, Minn.	394,655	4 55	18 60
New Orleans, La.	1,391,999	1 14	21 65
Jersey City, N. J.	108,858	1 56	24 85

* Does not include removal of ashes. ‡ Does not include removal of ashes and garbage.
† Does not include street-cleaning. § Includes county.

From this table it will be seen that for municipal purposes only, including education, but exclusive of state, county, and sinking fund and interest purposes, based on an assessable valuation arranged on a uniform basis, Indianapolis, Ind., has the lowest tax rate of all the cities enumerated, viz., $6.62 per $1,000, while Jersey City has the highest rate, viz., $24.85.

For a more complete analysis of this subject I again call your attention to the tabulated statistics attached to this report.

Before passing from this subject I desire to submit two tables on the bonded indebtedness of these cities.

First, a table showing the net bonded indebtedness of these cities on January 1, 1898, as well as the net bonded indebtedness per capita; and second, a table showing the amount of money produced by taxation in 1898 for bonded indebtedness and interest, as well as the amount produced per capita, as follows:

NAME OF CITY	Net Bonded Indebtedness	Net Bonded Indebtedness Per Capita
San Francisco, Cal	$133,917	$0 38
Chicago, Ill	15,449,414	8 35
Indianapolis, Ind	2,030,500	10 41
Denver, Col	1,955,300	12 22
Detroit, Mich.	4,679,897	15 59
Kansas City, Mo	3,513,080	20 07
Omaha, Neb	3,036,000	20 24
Columbus, O	3,181,961	23 50
Cleveland, O	9,079,732	23 89
Milwaukee, Wis	6,728,000	24 91
Toledo, O	5,064,616	30 88
Minneapolis, Minn	6,821,754	32 48
St. Louis, Mo	20,352,278	32 66
Albany, N. Y	3,269,000	32 69
Nashville, Tenn	3,307,000	33 07
Buffalo, N. Y	14,157,819	37 76
Louisville, Ky	8,584,000	38 66
Pittsburg, Pa	11,571,679	39 22
Allegheny, Pa	4,953,703	39 62
Newark, N. J	11,057,774	44 23
Philadelphia, Pa	56,872,795	45 87
Rochester, N. Y	8,081,959	46 18
New Orleans, La	14,444,390	48 18
St. Paul, Minn	8,922,483	54 07
Cincinnati, O	25,482,459	62 15
Baltimore, Md	31,794,178	63 58
Jersey City, N. J	15,491,542	70 74
Providence, R. I	12,972,145	78 14
Boston, Mass	51,482,168	97 33

NAME OF CITY	Amount of Money produced by Taxation in 1898 for Bonded Indebtedness, including Interest	Amount of Money produced by Taxation in 1898 Per Capita
San Francisco, Cal	$59,803	$0 17
Jersey City, N. J	108,858	54
Detroit, Mich	195,178	60
Omaha, Neb	109,063	72
Kansas City, Mo	135,500	77
Chicago, Ill	1,531,375	82
Buffalo, N. Y	393,079	1 04
Louisville, Ky	237,600	1 07
Cleveland, O	411,554	1 08
Denver, Col	219,304	1 37
Newark, N. J	354,235	1 41
Milwaukee, Wis	431,709	1 60
Rochester, N. Y	313,564	1 79
St. Paul, Minn	307,365	1 86
Minneapolis, Minn	394,655	1 87
Columbus, O	297,127	2 20
St. Louis, Mo	1,415,954	2 27
Nashville, Tenn	230,096	2 30
Toledo, O	391,375	2 38
Cincinnati, O	1,003,053	2 44
Indianapolis, Ind	508,201	2 60
Albany, N. Y	273,218	2 73
Allegheny, Pa	419,025	3 35
Baltimore, Md	2,018,834	4 03
Pittsburg, Pa	1,338,820	4 53
New Orleans, La	1,391,999	4 63
Philadelphia, Pa	6,038,063	4 95
Providence, R. I	1,034,881	6 02
Boston, Mass	4,268,579	8 06

From these tables it will be seen that Philadelphia has the largest bonded indebtedness, viz., $56,872,795.22, while San Francisco has the smallest, viz., $133,917.01. In the bonded debt, per capita, Boston is the highest, with $97.33, while San Francisco is the lowest, 38 cents. The average per capita debt of these cities is $37.48, fourteen cities being above and fifteen below the average.

Philadelphia raises more money by taxation per annum to provide for its bonded indebtedness, including interest, than any of the cities enumerated, viz., $6,038,063, while San Francisco raises the least, viz., $59,803. The amount of money raised per capita by taxation to provide for the bonded indebtedness, including interest, is $8.06 in Boston, this being the highest rate, as against 17 cents in San Francisco, this being the lowest rate.

The average per capita amount raised by taxation is $2.37, eleven cities being above and eighteen below the average.

The next table shows the amount of money produced in these cities in 1898 by taxation for all purposes—state, county, municipal, educational, and sinking fund and interest—not including, however, moneys received for these purposes from sources other than taxation, and showing also the per capita amount raised by taxation, the calculation being made by dividing the amount raised by the population of each city.

NAME OF CITY	Amount of Money raised by Taxation for all Purposes	Per Capita Am't of Money raised by Taxation
Nashville, Tenn.	$867,285	$8 67
Kansas City, Mo	1,777,760	10 15
Toledo, O	1,676,600	10 22
Omaha, Neb	1,557,457	10 38
St. Louis, Mo	6,584,186	10 56
Indianapolis, Ind	2,093,308	10 73
Cleveland, O	4,158,122	10 94
Newark, N. J	2,905,839	11 62
St. Paul, Minn	1,990,200	12 06
Chicago, Ill	22,390,567	12 10
New Orleans, La	3,758,397	12 19
Milwaukee, Wis	3,345,080	12 38
Columbus, O	1,692,497	12 53
Cincinnati, O	5,149,006	12 55
Louisville, Ky	2,809,620	12 66
Philadelphia, Pa	15,993,546	12 91
Jersey City, N. J	2,599,923	13 00
Minneapolis, Minn	2,741,358	13 04
Detroit, Mich	3,992,856	13 39
Rochester, N. Y	2,338,198	13 41
Albany, N. Y	1,365,537	13 65
Denver, Col	2,266,146	14 10
Allegheny, Pa	1,883,725	15 06
Buffalo, N. Y	5,783,180	15 42
San Francisco, Cal	5,962,740	17 04
Baltimore, Md.	8,826,741	17 65
Providence, R. I	2,995,709	18 04
Pittsburg, Pa	6,332,620	21 46
Boston, Mass	14,090,458	26 64

From this table it will be seen that for all purposes combined Chicago raises the most money, viz., $22,390,567, while Nashville, Tenn., raises the least, viz., $867,285. The highest per capita amount assessed for all purposes by taxation is $26.64, in the city of Boston, while the lowest amount is $8.67, in Nashville, Tenn. The average per capita rate is $18.83, eight cities being above and twenty-one below the average. This average is obtained by dividing the total amount of money raised in these cities by the total population.

I have prepared one other table that, in my judgment, has quite a bearing on this subject. The amount of the total tax rate is necessarily dependent upon the available assessable returns, and in order that this feature may be considered intelligently I present the table above referred to, which shows the assessable valuations for taxable purposes in these cities, arranged on a uniform basis by assessing real estate at 75 per cent of its true value, taking as a basis of calculation the assessable valuations and percentages at which real estate is now returned, and then showing the per capita return on such a basis, as follows:

NAME OF CITY	Total valuation on a uniform basis of 75 per cent of true value of Real Estate.	Returns for Taxation Per Capita.
Jersey City, N. J	$69,358,956	$346 00
Nashville, Tenn.	35,399,390	354 00
New Orleans, La	122,147,228	407 00
Minneapolis, Minn	86,705,851	413 00
Toledo, O	69,500,000	424 00
Omaha, Neb	67,330,082	448 00
Allegheny, Pa	56,625,000	453 00
Milwaukee, Wis	163,322,824	469 00
Louisville, Ky	118,800,000	535 00
Albany, N. Y	58,482,120	585 00
Newark, N. J	146,271,469	585 00
Cincinnati, O	244,006,522	595 00
Kansas City, Mo	113,250,000	604 00
Rochester, N. Y	106,424,411	608 00
Columbus, O	87,515,745	641 00
Indianapolis, Ind	126,819,078	650 00
St. Louis, Mo	409,821,885	658 00
Denver, Col	109,652,227	685 00
Pittsburg, Pa	201,298,625	686 00
Cleveland, O	263,919,535	694 00
Philadelphia, Pa	864,516,035	698 00
Buffalo, N. Y	262,133,595	699 00
Chicago, Ill	1,306,254,420	706 00
Baltimore, Md	362,122,738	724 00
Detroit, Mich	226,424,333	755 00
Providence, R. I	145,875,570	879 00
St. Paul, Minn	161,687,500	979 00
San Francisco, Cal	351,784,094	1,005 00
Boston, Mass	828,514,369	1,566 00

From this table it will be seen that the returns for taxation per capita, arranged on a uniform basis of assessing real estate at 75 per cent of its true value, averages $708 in these cities, six cities being over and twenty-three under the average. The returns in Boston per capita are $1,566, this being the highest, while in Jersey City the returns are $346, this being the lowest. These averages are obtained by taking the combined assessable valuations divided by the combined population. From this table it will also be seen that, as a rule, those cities which have the lowest tax rate, as shown in the tables herein referred to, have the highest returns per capita for assessable purposes, which enables those cities to have the low rate.

I shall now take up and present some statistics that were obtained in reply to question 9, viz.: "*What is the appropriation or estimated expenditure for police, fire, light, street-cleaning, and educational purposes in* 1898, *including amount received from taxes and all other sources of revenue?*"

From the answers received to this question I have prepared five tables showing the per capita amount expended for each of these purposes in all of the cities enumerated.

In making comparisons of the tax rates of the various cities, these items of expenditures can well be taken into consideration, and is in itself an interesting study, as it covers five principal items of expense.

These tables are as follows:

Amount Expended for Police Purposes.

Name of City.	Per Capita.	Name of City.	Per Capita.
Boston, Mass.	$3 19	St. Paul, Minn	$1 12
Philadelphia, Pa	2 18	Allegheny, Pa	1 09
San Francisco, Cal	2 11	Minneapolis, Minn	1 06
Buffalo, N. Y	2 06	Cleveland, O.	1 04
Providence, R. I	2 02	Louisville, Ky	1 02
Jersey City, N. J	1 98	Kansas City, Mo	98
Baltimore, Md	1 96	Columbus, O	96
Chicago, Ill	1 80	Rochester, N. Y	95
Detroit, Mich	1 78	Nashville, Tenn	87
Albany, N. Y	1 59	New Orleans, La	79
Pittsburg, Pa	1 55	Toledo, O	78
St. Louis, Mo	1 54	Denver, Col	77
Newark, N. J	1 48	Indianapolis, Ind.	71
Cincinnati, O	1 40	Omaha, Neb	61
Milwaukee, Wis	1 22		

Amount Expended for Fire Purposes.

Name of City.	Per Capita.	Name of City.	Per Capita.
Boston, Mass	$2 21	Jersey City, N. J	$1 09
Providence, R. I	2 11	Cincinnati, O	1 07
Detroit, Mich	1 86	Allegheny, Pa	1 05
Buffalo, N. Y	1 67	New Orleans, La	1 02
Minneapolis, Minn	1 64	Baltimore, Md	1 01
Milwaukee, Wis	1 54	Newark, N. J	96
Albany, N. Y	1 41	Louisville, Ky	93
Pittsburg, Pa	1 39	Denver, Col	88
Columbus, O.	1 33	Nashville, Tenn	87
Rochester, N. Y	1 31	Indianapolis, Ind	85
Cleveland, O	1 28	Chicago, Ill	80
San Francisco, Cal	1 23	Philadelphia, Pa	79
St. Paul, Minn	1 21	Toledo, O	76
St. Louis, Mo	1 20	Omaha, Neb	62
Kansas City, Mo.	1 13		

Amount Expended for Educational Purposes.

Name of City.	Per Capita.	Name of City.	Per Capita.
Minneapolis, Minn	$5 38	Allegheny, Pa	$3 04
Denver, Col	4 69	Albany, N. Y.	2 97
Boston, Mass	4 67	Baltimore, Md	2 86
Cleveland, O	3 78	Omaha, Neb	2 80
Indianapolis, Ind.	3 58	Milwaukee, Wis	2 67
Columbus, O	3 52	Pittsburg, Pa	2 62
San Francisco, Cal	3 52	St. Paul, Minn	2 58
Kansas City, Mo	3 43	Buffalo, N. Y	2 57
Chicago, Ill	3 32	Toledo, O	2 35
Rochester, N. Y	3 25	Jersey City, N. J	2 01
Philadelphia, Pa	3 24	Newark, N. J	1 96
Providence, R. I	3 16	Nashville, Tenn	1 80
St. Louis, Mo	3 14	Louisville, Ky	1 54
Cincinnati, O	3 11	New Orleans, La	1 29
Detroit, Mich	3 06		

Amount Expended for Light Purposes.

Name of City.	Per Capita.	Name of City.	Per Capita.
Providence, R. I	$1 69	St. Paul, Minn	$0 69
Rochester, N. Y	1 31	Jersey City, N. J	66
Boston, Mass	1 23	St. Louis, Mo	61
Philadelphia, Pa	1 06	Cleveland, O	60
San Francisco, Cal	1 00	Denver, Col	58
Buffalo, N. Y	91	Chicago, Ill	55
Albany, N. Y	88	Columbus, O	54
Pittsburg, Pa.	85	Louisville, Ky	53
Allegheny, Pa	84	Indianapolis, Ind	53
Cincinnati, O	82	Nashville, Tenn	53
Minneapolis, Minn	81	Detroit, Mich	41
Newark, N. J	80	Kansas City, Mo	40
Baltimore, Md	75	Omaha, Neb	32
Milwaukee, Wis	70	Toledo, O	27
New Orleans, La	70		

Amount Expended for Street-cleaning Purposes.

Name of City.	Per Capita.	Name of City.	Per Capita.
Rochester, N. Y.	$1 41	Kansas City, Mo	$0 40
Pittsburg, Pa	1 14	San Francisco, Cal	39
Buffalo, N. Y	1 06	Newark, N. J	38
Allegheny, Pa	84	St. Louis, Mo	38
Baltimore, Md	77	Louisville, Ky	37
Philadelphia, Pa	73	Chicago, Ill	33
New Orleans, La	70	† St. Paul, Minn	30
Minneapolis, Minn	64	Denver, Col	29
Boston, Mass	60	Indianapolis, Ind	28
Milwaukee, Wis	57	Jersey City, N. J	26
Cincinnati, O	46	Nashville, Tenn	25
Detroit, Mich	43	Toledo, O	20
* Providence, R. I	42	Omaha, Neb	14
Cleveland, O	42	Columbus, O	Spec. ass'm't
Albany, N. Y	42		

---

* Does not include removal of ashes and garbage.
† Does not include removal of ashes.

An examination of these tables will show that for police purposes the amount expended per capita in Boston, $3.19, is the highest, and Omaha, Neb., 61 cents, is the lowest, the average per capita in all of the cities being $1.66, nine cities being above and twenty below the average. For fire purposes the amount expended per capita in Boston, $2.21, is the highest, and Omaha, Neb., 62 cents, is the lowest, the average per capita in all of the cities being $1.17, fourteen cities being above and fifteen below the average. For educational purposes the amount expended per capita in Minneapolis, Minn, $5.38, is the highest, and New Orleans, La., $1.29, is the lowest, the average per capita in all of the cities being $3.14, twelve cities being above and sixteen below the average. For lighting purposes the amount expended per capita in Providence, R. I., $1.69, is the highest, and Toledo, O., 27 cents, is the lowest, the average per capita in all of the cities being 76 cents, twelve cities being above and seventeen below the average. For street-cleaning purposes the amount expended per capita in Rochester, N. Y., $1.41, is the highest, and Omaha, Neb., 14 cents, is the lowest, the average per capita in all of the cities being 51 cents, ten cities being above and eighteen below the average.

All of the averages are obtained by taking the total amount expended for each of these purposes in all of the cities divided by the combined population.

In preparing this report, I endeavored to secure accurate information relative to the sources of income in all of these cities, exclusive of taxation (estimated for 1898), classified under the following headings:

Unexpended Balances and Earnings;
Liquor Licenses, including Tobacco;
Street Railroad License and Fees;
General and Vehicle Licenses;
Fees, Fines, Costs, and all other miscellaneous items.

This, however, to cover only so much of such income as is devoted to maintaining municipal departments.

While I have secured the figures in nearly every instance, a careful examination thereof indicates that there are too many inaccuracies in the classifications under the first and last heading to present reliable statistics. I shall, therefore, only present in condensed form in this report the statistics tabulated with respect to the liquor, street railroad, general, and vehicle license receipts in these cities.

I have prepared three tables on this subject, showing the total amount and per capita amount received under the following headings:

Liquor Licenses, including Tobacco;
Street Railroad Licenses and Fees;
General and Vehicle Licenses.

In making comparisons as to total tax rates, receipts of this character should be carefully considered.

These tables are as follows:

NAME OF CITY	Total Estimated Amount received for Liquor License, incl'ding Tobacco (City's Portion)	Per Capita Amount received
Boston, Mass	$1,085,000 00	$2 05
Omaha, Neb	268,000 00	1 79
St. Paul, Minn	275,000 00	1 67
Chicago, Ill	3,025,418 80	1 64
Pittsburg, Pa	480,000 00	1 63
Albany, N. Y	157,000 00	1 57
Buffalo, N. Y	580,000 00	1 55
St. Louis, Mo	945,000 00	1 52
Minneapolis, Minn	299,000 00	1 42
Philadelphia, Pa	1,690,047 50	1 36
Newark, N. J	335,000 00	1 34
Jersey City, N. J	255,908 00	1 28
Allegheny, Pa	160,000 00	1 28
Milwaukee, Wis	333,590 13	1 23
Denver, Col	195,400 00	1 22
Cleveland, O	427,000 00	1 12
San Francisco, Cal.	380,000 00	1 08
Cincinnati, O	427,000 00	1 04
Rochester, N. Y	174,000 00	1 00
Baltimore, Md	410,000 00	82
Detroit, Mich	225,000 00	75
Indianapolis, Ind	140,016 00	72
Toledo, O	100,000 00	61
Kansas City, Mo	102,000 00	58
Louisville, Ky	126,455 83	57
Columbus, O	70,000 00	52
New Orleans, La	149,000 00	50
Nashville, Tenn	17,250 00	17

NAME OF CITY	Total Estimated Amount received for Street Railroad License and Fees	Per Capita Amount received
Baltimore, Md	$266,000 00	$0 53
Cincinnati, O	180,000 00	44
Allegheny, Pa	25,000 00	20
Milwaukee, Wis	48,676 55	18
St. Louis, Mo	92,100 00	15
Louisville, Ky	30,863 16	14
Buffalo, N. Y	46,000 00	12
Pittsburg, Pa	30,000 00	10
Detroit, Mich	22,000 00	07
Philadelphia, Pa	77,744 00	06
Rochester, N. Y	9,000 00	05
Kansas City, Mo.	9,000 00	05
Chicago, Ill	80,532 74	04
New Orleans, La	8,000 00	03
Denver, Col	4,000 00	03
San Francisco, Cal	10,000 00	028
Cleveland, O	7,800 00	02
Newark, N. J	4,000 00	02
Minneapolis, Minn	3,700 00	02
Nashville, Tenn	2,150 00	02
Boston, Mass	500 00	....
Jersey City, N. J	....	....
Omaha, Neb	....	....
St. Paul, Minn	....	....
Indianapolis, Ind	....	....
Albany, N. Y	....	....
Columbus, O	....	....
Toledo, O	....	....
Rochester, N. Y	No answer	received.

NAME OF CITY	Total Estimated Amount received for General and Vehicle Licenses	Per Capita Amount received
Nashville, Tenn	$83,000 00	$0 83
St. Louis, Mo	434,000 00	70
Allegheny, Pa	82,490 00	66
Pittsburg, Pa	185,000 00	63
Kansas City, Mo	107,000 00	61
New Orleans, La	168,000 00	56
Louisville, Ky	120,698 29	55
San Francisco, Cal.	112,000 00	32
Cincinnati, O	110,800 00	27
Indianapolis, Ind	50,148 20	26
Denver, Col	40,758 82	25
Milwaukee, Wis	53,440 03	20
Omaha, Neb	24,000 00	16
Toledo, O	22,000 00	13
Baltimore, Md	65,000 00	13
Buffalo, N. Y	45,000 00	12
Boston, Mass	44,500 00	08
Cleveland, O	28,200 00	08
Newark, N. J	16,500 00	07
Minneapolis, Minn	13,992 88	07
Philadelphia, Pa	93,264 21	07
Detroit, Mich	16,000 00	05
St. Paul, Minn	9,000 00	05
Albany, N. Y	4,386 00	04
Jersey City, N. J	8,781 30	04
Columbus, O	350 00	03
Rochester, N. Y	....	....
Chicago, Ill	No answer	received.
Providence, R. I	No answer	received.

These three tables also represent an interesting study. The per capita amount received from liquor licenses in Boston, $2.05, is the highest, and 17 cents in Nashville the lowest. Street railroad licenses and fees run from 53 cents per capita in Baltimore down to nothing in a number of cities, while general and vehicle licenses run from 83 cents in Nashville, Tenn., down to 4 cents in Albany, N. Y., and Jersey City.

Before closing my report I wish to call your attention to the fact that it is almost impossible to secure reliable and accurate data on subjects of this character because of the many systems in vogue in the leading cities of the United States.

It has therefore occurred to me that our association might in some way take the initial step toward inaugurating and securing a uniform system of assessing property, levying taxes, classifying receipts, distributing revenue, and the classification of expenditures, with a view to its adoption by all the larger cities of the country.

The beneficent results of such a system would be that accurate information could be secured at any time and upon any subject, and proper comparisons could be made, thereby preventing to a great extent the severe and unjustifiable criticism of public officials that is so often made through the press and the public, and which is, as a rule, based upon "comparative figures."

This in my judgment could be easily accomplished by following a few simple rules:

First—All property to be assessed at the same value for taxable purposes in all cities.

Second—Taxes to be levied in all cities under the same classified headings.

Third—Revenues from all purposes to be classified in all cities under same headings. As an illustration, I will follow the method of classification as suggested by Dr. L. S. Rowe of the University of Pennsylvania, who has given much study to this subject, as follows:

ORDINARY MUNICIPAL REVENUE.—This to be divided into chapters.

Chapter 1.

(*a*) *Taxation*—To include taxes, real and personal, arrears, delinquent, etc.

(*b*) *Special Assessments*—To include the improvement of streets, sewers, sidewalks, opening streets, etc.

(*c*) *Miscellaneous*—Sale of old material, etc.

(*d*) *Licenses and Fees*—To include all licenses, fees, permits, etc.

(*e*) *Franchises.*

Chapter 2. Income from public institutions, including waterworks, markets, hospitals, charitable and correctional institutions

Chapter 3. Income from investments, including interest on bank deposits and bonds.

Chapter 4. Gifts and subsidies, including amount received from state taxes for school funds; also foreign insurance companies, etc.

Chapter 5. EXTRAORDINARY REVENUE.—Income from loans, bonds, tax-certificates, etc.

Fourth—Revenues from all purposes to be distributed in the same manner in all cities.

Fifth—Appropriations to be made in the same manner and classified under same headings in all cities.

Sixth—Expenditures to be classified under same headings in all cities.

In connection with this suggestion, I desire to call attention to the fact that in Ohio the General Assembly, on April 26, 1898, passed an act to establish a board of commissioners for the promotion of uniformity of legislation in the United States. Sections 1 and 2 of this act are as follows:

"SECTION I. *Be it enacted by the General Assembly of the State of Ohio,* That the Governor shall, within thirty days after the passage of this act, appoint three suitable persons, who are hereby constituted a board of commissioners by the name and style of commissioners for the promotion of uniformity of legislation in the United States. The said commissioners shall meet and organize within thirty days after the said board shall be appointed, and shall hold office for a term not exceeding two years from the day of such organization. Any vacancy in the office of such commissioner, by resignation or otherwise, shall be filled for the unexpired term of appointment by the appointment of a suitable person by the Governor. The Governor may remove for cause any or all of said commissioners.

"SECTION 2. It shall be the duty of said board to examine the subjects of marriage and divorce, insolvency, the form of notarial certificates, acknowledgment of deeds, negotiable instruments, execution and probate of wills; to confer upon these matters with the commissioners appointed for the same purpose by any other state or states; to ascertain the best means to effect an assimilation and uniformity in the laws of the states upon these subjects, and especially to consider whether it would be wise and practicable for the State of Ohio to join with any other state or states of the Union in extending an invitation to other states to send representatives to a convention to draft uniform laws to be submitted for adoption by the several states."

While municipal matters of the kind presented in this report are not covered by this act, it seems to me that possibly it might be a judicious move if this association should request that commission to take this subject into consideration. Being personally acquainted with some of the members, I suggest that such action be taken, believing that a request from this association would be given proper consideration by them.

I also understand that there are fourteen other states throughout the country who have taken almost similar legislative action with a view of establishing a joint commission looking towards the promotion of uniformity of legislation throughout the United States.

In conclusion, I desire to return my thanks to all of those who have assisted me in securing the information for this report, and now submit the same for your consideration and discussion.

Respectfully,

AUG. HERRMANN.

CINCINNATI, OHIO.

JNICS.

ctober 2

....	....	....	....	....	....
....	....	} 115,000 00	....	....	....
00 00		} 230,000 00		Rail Natur	roads } 432,000 00 algas } 1,150,000 00
00 00 45 75	17. 2.	4,754,860 00 1,485,860 00	....	....	$5,632,346 00 567,729 61
54 25	$15.	$3,269,000 00	$3,807,800 00	$1,955,800 00	$5,064,676 39
wers. and de on an.	No; ne ments etc., a assess	mprovement of ets, sewers, and walks made on ssment plan.	Property-holders pay for sidewalks. All other improvements are paid from the General Fund.	No.	All sewer, street, and sidewalk improvements made on assessment plan, except intersections, which are paid from fund realized from sale of Intersection bonds.
ter-	No; ex	except water-rents.	No; except for sidewalks as above and water-rents.	No; except water-rents.	No; except water-rents.
......	....	Yes.	Yes, See Exhibit "C"	Yes.	Yes.
......	....	....	....	....	....

Mr. M. F. McLaughlin: Mr. President, I move that a vote of thanks be given to the gentleman for the very able paper which has just been read by him.

The motion was agreed to unanimously.

The President: Any discussion or inquiries in reference to this paper will be in order at this time.

Mr. Sherrerd: Might it not be possible, Mr. President, to get advance copies of the large tabular statement submitted by Mr. Herrmann? We do not want to wait a whole year before seeing it.

The President: The Chair feels justified in saying that an effort will be made this year to have our reports printed very promptly. Is not that so, Mr. Secretary?

The Secretary: Yes; I have no doubt of it.

Mr. Herrmann: I might say that the paper I have read has been set up in type, and will be extensively circulated in Cincinnati, from which city I come.

Mr. Sherrerd: Then I move that the Secretary be instructed to send copies of this paper to the members of the society at as early a date as possible, Mr. Herrmann having stated that it is all set up.

The motion was agreed to.

The President: Inasmuch as there is something rather uncomplimentary in that report with reference to Jersey City, and as there is no representative here from Jersey City, the Chair thinks it fair to state that the whole water front of Jersey City, extending some miles, is under the control of large railroad interests; that they are taxed through the State Tax Board; and that Jersey City gets only a small proportion relatively of the tax on this whole water front, involving many million dollars.

Mr. Herrmann: Mr. President, I have eliminated the State tax from the municipal tax in some of the tables.

REPORT OF A COMMISSION OF EXPERTS CONCERNING THE AGRICULTURAL UTILIZATION OF VIENNA SEWAGE.

(Translated by Captain Lansing H. Beach, Corps of Engineers, U. S. A., Washington, D. C., 1898.)

A large number of sewers empty into the Danube canal in Vienna along both its banks and carry to the river the sewage from over a million people in the thickly-built portion of the city. By the national law of July 18th, 1892, concerning the accomplishment of the commercial plan in the national capital and residence city of Vienna, provision was made, among other things, for the construction of trunk-intercepting sewers, which should take the sewage and carry it to the main channel of the Danube. In the law the future utilization of sewage for agricultural purposes was kept in view, as appears by the following quotation from Article V:

"In preparing the project for the intercepting sewers, consideration will be so given to the future irrigation of the Marchfeld with the contents of these intercepting sewers, that the construction of a system for the purpose of this irrigation will be rendered possible."

With similar intent the House of Deputies had, on May 18th, 1892, adopted the following resolution:

"The government is requested to cause information to be collected concerning the manner in which the closet material of the City of Vienna can be reasonably made available for agriculture."

In order to give effect to these resolutions and to submit such weighty questions relating to agricultural matters to a detailed discussion and examination, the Ministry of Agriculture convened a commission of experts, which assembled May 8th, 1893, under the chairmanship of his excellency, the Minister of Agriculture, Count Falkenhayn.

The following took part in this inquiry:

His excellency, the Minister of Agriculture, Julius, Count Falkenhayn, as presiding officer.

As representative of the royal and imperial Minister of the Interior: Franz Wetschl, member of the Royal and Imperial Council.

As representative of the Governor of the lower Austria: Ernst Oser, royal and imperial member of the council to the Governor, and Otto Ritter von Freydenegg, royal and imperial member of the District Council.

As representative of the lower Austrian chamber: Wilhelm Wodica, agricultural engineer.

As representative of the municipality of Vienna: George Rosenstingl, engineer and member of the council, and Joseph Kohl, Chief Engineer City Board of Public Works.

As representative of the Royal and Imperial Agricultural Association in Vienna: Dr. Emerich Meissl, Director of the Royal and Imperial Chemical Experimental Station of Agriculture in Vienna.

As representative of the Austrian Engineers and Architects' Society: Johsnn Ritter von Schon, royal and imperial member of council, Austrian professor in the Royal and Imperial University in Vienna.

Also the following:

Peter Freiherr von Pirquet, landowner, member of the reichsrath and landtag.

Dr. Emil Perels, Austrian professor in the Royal and Imperial University for Agriculture in Vienna.

Johann von Podhagsky, civil engineer, authorized by the commission.

The following attended from the Royal and Imperial Bureau of Agriculture:

His excellency, Dr. Ferdinand Edler von Blumfeld, chief of division;

Anton Ritter von Rinaldini, chief of division;

Anton von Pretis Cagnodo, royal and imperial member of council;

Eduard Markus, royal and imperial member of council, technical expert for affairs of improvement as statistician;

Wilhelm Becker, royal and imperial member of council, technical expert for agricultural operations.

All present recognized the importance of the subject and were unanimous in the opinion that a smaller committee should first be selected, which would make a preliminary collection of data and in turn come before the Expert Commission with concrete propositions.

For this committee were selected:

Chief Engineer Joseph Kohl,
Regierungsrath Eduard Markus,
Professor Dr. Emerich Meissl,
Peter Freiherr v. Pirquet,
Civil Engineer v. Podhagsky,
Ministerialrath Franz Wetschl,
Agricultural Engineer Wilhelm Wodica.

The committee set itself to the task given it, and embodied its knowledge and views in a report submitted in May, 1894.

This report and its appendices were forwarded to all the members of the Expert Commission for information and examination.

At the final session of the commission, held November 14th, 1894, this report was considered, and after a thorough discussion of the resolution proposed by the committee, was adopted, being as presented, except for the addition to the last sentence of paragraph seven, upon the motion of Prof. Schon.

Report of the Sub-Committee of the Expert Commission Convened by the Royal and Imperial Ministry of Agriculture, upon the Question of the Agricultural Value of the Vienna Sewage.

For years the municipal authorities of all large European cities have regarded as one of their weightiest problems the removal of fecal matter and waste water beyond the boundaries of the city in a suitable, and above all, in a hygienic manner. Only seldom is consideration given to the idea to make this disposition in such a manner as not to leave the valuable sewerage unused as fertilizer, but to apply it to agricultural purposes, and thus be able to turn it to the advantage of farming.

This question has also been repeatedly brought into discussion in Vienna in the course of the past ten years.

The Commission of Experts convened by the lower Austrian chamber, in 1877, to examine the project of irrigating the March tract by means of an irrigating canal starting from the Danube opposite Greifenstein (v. Podhasky), took this question quite thoroughly into their deliberations and expressed their conclusion in the following resolution:

"The vicinity of the City of Vienna would cause it to appear very desirable to increase the fertilizing power of the water in a high degree by carrying the sewage of the city in the irrigating canals."

This feature of the program was one of the most important when the Royal and Imperial Ministry of Agriculture convened a Commission of Experts May 8th, 1893, for an expression of opinion. From the presentation of the case by his excellency, the Royal and Imperial Minister of Agriculture, it was seen that the problem consists as much in keeping in view the possibility of irrigating the March fields with sewage as in discussing the question of commercial value of sewage in general.

The commission must therefore follow the initiative of the Royal and Imperial Minister of Agriculture, as stated, to find, if possible, a plan which would either promote farming and meadow culture of a large section, or to create a fertilizing product in the condition, which might exert a favorable effect upon agricultural production in general.

At the same session it was decided to intrust the already formed Committee of Seven with the work of holding the necessary preliminary conferences, and in due time, of making a report with suitable propositions to the commission.

As further special points for the preliminary conference of the subcommittee, the following resolutions of the commission were given it as instructions:

1. To ascertain the amount of plant food and the value of Vienna sewage, analyses of the latter are to be made.

2. Estimates of cost are to be worked out for collecting the sewage at the Stadlauer bridge, or some other designated point, and for carrying it to the place for its application to filtration beds or to agricultural purposes.

3. Since the filtration of undiluted sewage in large quantities could not be recommended, investigations are to be made concerning its sedimentation, in order that at least a portion of the plant food contained in it may be rendered available for agricultural purposes.

4. In view of the lack of knowledge which still exists with regard to several phases of the agricultural value of the city sewage, plans for experimental fields for irrigation in various ways are recommended, and particularly:

(a) for the raising of vegetables,
(b) for a system of mixed crops.

5. Study is to be given to the question whether a profitable and reasonable utilization can be made of the Vienna sewage by taking it through the canals to serve for the future irrigation of the Marchfelds, and if so, to what extent.

6. Projects and preliminary plans are to be prepared for carrying out the scheme of collecting and pumping the sewage at the Stadlauer railroad bridge.

7. It is to ascertain whether the utilization of the sewage according to the Hobohn plan of collecting it and transporting it in barges upon one of the canals crossing the Marchfeld in the direction of Gross Enzersdorf-Augern, after previous partial sedimentation, appears judicious, and if so, to what extent.

The problem which the committee had, therefore, to solve might well be designated as a very comprehensive one. It was the harder to treat, as the opinion had extended abroad so extensively, and particularly in agricultural circles, that it would be an easy thing to utilize the city's excretal products, and that it would be inexcusable not to provide for the proper application of the sewage and sediment so valuable as a fertilizer.

And yet it is proved to the contrary, if one gives consideration to the experiences of other cities, that where the fecal materials of a city are taken away by the water carriage system, as in Vienna, no place has yet succeeded by raising it and applying it, either directly or prepared, to agricultural purposes as fertilizer, in bringing it into a condition even approaching a profit upon the capital expended.

Under the impression of a probably negative result to their investigations, the sub-committee had to begin its task, taking special care to proceed as thoroughly as possible.

The sub-committee feels honored in presenting the reports of its members to the Commission of Experts, and states its conclusions in the following:

The observations made establish the fact that at present the sewage discharge in Vienna is to be reckoned as about one cubic metre per second, and that in the course of years it may be expected to increase to four cubic metres.

The amount of fertilizing material contained in a cubic metre of sewage (including the sediment) is reckoned as worth between 3.5 and 15.7 kreutzers. From this it is figured that at the present time (with one cubic metre discharge) the value of the fertilizing material per day is, in round numbers, 3,300 to 14,700 florins, the value in the course of a year amounting to from 1,200,000 to 5,300,000 florins.

Even by the statement of the lower figures it is evident that a considerable value is contained in this sewage; it is the more to be regretted that at present no means appear to be available either to transport or to work up this fertilizing material in a profitable manner. The trouble lies in the fact that the proportion of dissolved or suspended useful fertilizing material is so small compared to the volume of water and to the useless portion of the sediment.

There is found, for instance, according to the observations made, in each 1,000 kilogrammes of sewage merely:

fertilizing material (dissolved) to the value of 3.05 kreutzers;
sediment to the value of 0.51 kreutzers.
Total value approximately 3.5 kreutzers.

These results are the average of only a comparatively small number of observations. Although it may be taken for granted that the numbers found will not differ essentially from the yearly average, still the measurements concerning volume of flow and the analyses must be systematically carried on for a longer period of time, if entirely reliable results are to be obtained.

If now the problem were placed before us to investigate which of the existing most commonly encountered systems of agricultural utilization were best adapted to serve profitably for Vienna sewage, we would come to the following results:

A.

A direct transportation of these volumes, whether by wagon or boat, to be used directly as fertilizer upon the ground, is completely out of the question.

A wagon-load of 20 hectolitres (20 quintals) of sewage would be worth merely from 7 to 31.4 kreutzers.

Loads of such relatively small values do not permit transportation to any considerable distance, as would be necessary in order to be able to apply these large volumes profitably to extended agricultural surfaces.

B.

On account of too great dilution, the reduction to poudrette at a profitable price appears to be excluded.

To-day no process is known which might be available. in view of such extensive dilution, to separate from the water the constituents useful as fertilizer and to reduce them to useful and transportable form for agricultural purposes, without a disproportionately great cost.

Experience teaches that poudrette factories can maintain themselves only with difficulty in those places where highly concentrated fecal matter is available, as for instance in the cases of the cask system or the Liernur system.

C.

Just as little can the sedimentation method be recommended at this date.

The large cost of the plant, as also the operating expenses, would be out of proportion to the desired price for the product, owing to the unfavorable proportion of fertilizer to volume of water, and also to the small value of sediment.

A profit from such a system appears, therefore, to be out of the question.

D.

The utilization of the sewage by pumping and conducting it to a direct irrigation of agricultural lands offers great difficulties.

The Marchfeld on the left bank of the Danube would, both by character of ground and by extent, offer an opportunity for irrigation upon a large scale; but the examples before us of similar systems existing elsewhere do not permit the condition of probable profit from the plant to be regarded as secured. In Berlin, as in Paris, a great growth of plants is assisted by irrigation, but the interests of agriculture itself, upon a large scale, are not yet served, for this sort of fertilization is confined so far to comparatively limited areas; its use does not reach the farms of a whole region, but benefits, more or less, only special groups of favored parties. The establishment of the first plant encounters considerable difficulty also if the ground necessary is not held by one party; in the case of a previous irrigation system with clean water, an actual overfertilizing of particular tracts and consequently a great waste of fertilizing material occurs; a preliminary draining of the fields, consequently a very expensive preparation, is necessary—further matters which come in the way of realizing a profit.

The proper object, which, for example, the City of Berlin follows since it has taken upon itself the heavy cost of pumping the sewage and carrying it off for irrigation purposes, does not consist in the advancement of agriculture in general, but much rather in disposing of this sewage in a sanitary manner, so that it may be rendered harmless and the Spree be less polluted. This condition does not occur in our case, as Vienna is so fortunate as to be situated upon the mighty Danube, which even at low water has a flow of about 1,400 cubic metres per second, so that one can say unhesitatingly and without fear of contradiction that its fecal matter is thoroughly carried away.

When the further expensive crossing of the Danube is considered, whether by means of a conduit or a bridge, a profit upon the cost of installation, judging from the examples of Paris and Berlin, is not to be expected, although in Paris (Gennevilliers) particularly large profits have accrued to the usufructuaries of the system.

We miss, therefore, in the method of a direct irrigation with undiluted sewage any previous suppositions which would cause us to advise at the present time the execution of any such plan for the Marchfeld, and in no case can it be recommended until improved methods for such a disposition have become known, or, in the case of this failing, the most thorough study has been undertaken.

With regard to the right bank of the Danube, this region is not adapted to irrigation upon a large scale, because, as far as can be determined without a detailed study, only a very limited area is available. The high ground lies at too great an elevation, and the raising of the sewage to it would be too expensive for any profit from the system to be at all probable. The immediate neighborhood of the city would still further diminish even this limited area, because the foul odor which the irrigation fields sometimes send abroad would scarcely permit it to be established too close to the town.

But it must be strongly stated that there, particularly, the favorable opportunity appears to be offered to establish irrigation fields under favorable conditions, even if only on a small territory.

As soon as the intercepting sewer on the right side has been completed, a pattern (experimental) plant can be created. The construction of such appears from several points of view as worthy of recommendation. It would, first of all, act to stir up and educate the people, and the irrigation would probably, in a manner similar to the case at Gennevilliers, near Paris, be extended, in the course of a few years, through the initiative of the people themselves living on the edges.

E.

Concerning the eventual conduction of Vienna sewage by a trunk canal to the projected Marchfeld irrigation system, it may be said that particularly favorable conditions would be offered by such an arrangement.

Upon the basis of the lower figures computed in Appendices I and II, as to the value of Vienna sewage, and taking 30% of this value as lost by flushing the intercepting sewers, etc., as well as charging the construction of a bridge across the Danube to the cost of the undertaking; so that it is, after cautious calculation, a profitable return of more than 5% upon the capital results from the value of the fertilizer supplied and its complete use.

To be sure, the opinion has been expressed that by the so-called "self-purification of a river" a very considerable escape in value of fertilizing material must result, which would make any calculation for return of profits appear doubtful.

These unfavorable suppositions can, however, not be recognized as valid without further evidence. It would be very desirable—by scientific research, by practical experiments, and by examination of each place where similar conditions exist—to obtain a complete answer to the question, whether and how far the sewage retains its fertilizing properties with strong dilution and long transportation, and it might be recommended to the Royal and Imperial Ministry of Agriculture to take the proper initiative in this matter.

The irrigation of the Marchfeld exists so far only as a project. However desirable its accomplishment may appear, it seems to be still in the distant future. In spite of this it can be stated, outside of the above question, that the project itself with its completion—that is, the conduction of Vienna sewage—will undergo a detailed re-examination. For, if the indicated uncertainties are removed, and the value of the sewage determined by further experiments, and the estimates of cost known by detailed projects to be correct, it would then follow: That by the completion of this combined project 35,000 to 69,000 hectares, and also an entire district, would share in the fertilizing; that this district would be in condition to receive the expected greater flow of sewage in the future; that, further, there would be some prospect for a profitable return from the undertaking, and that also, as far as human foresight goes, in this manner the question of agricultural value of Vienna sewage could be properly solved.

Considering these conditions, the sub-committee moves that the Expert Commission take cognizance of this report and adopt the following resolution:

"It is stated with satisfaction that the extension of the Vienna main intercepting sewer is approaching completion in the near future and that it offers the possibility hereafter of collecting the sewage in one suitable place to be raised and transported for utilization.

"The sewage contains fertilizing material which is of special value for agriculture. Its utilization offers a great politico-economical interest, and no efforts should be spared to find the correct means to render this utilization possible, and by that means prevent such rich fertilizing material from continuing to flow to waste.

"The extraction and utilization of the fertilizing material encounters, however, great difficulties, here as well as elsewhere, as soon as a profitable return upon the amount expended is demanded.

"The portion of fertilizing material to the volume of water and the worthless, heavy materials is, according to observation hitherto made, so unfavorable that a direct carrying of the sewage by wagon or boat to the fields appears, even for small distances, to be out of the question.

"This unfavorable proportion of mixture brings also the difficulty that, according to the present state of experience and methods, the cost of separating the fertilizing materials suitable for agricultural purposes by manufacture of poudrette or by sedimentation would not stand in any allowable ratio to the cost of the product obtained.

"The direct irrigation with undiluted sewage—according to the irrigation system applied in Berlin, for example—has not yet been extended to an entire district, and is serviceable chiefly only to a group of interested parties. The methods of irrigation so far in use demand large special and general expenses. By the construction of an irrigation system for the Marchfeld, the necessity for a crossing over the Danube river would increase the first estimate to such an unfavorable extent that it would fall as a burden upon a relatively limited area.

"The profitableness of such an undertaking appears, therefore, highly questionable, and the construction of such an irrigation plan for the Marchfeld cannot, therefore, be advised, at least until such time as by the perfection of preceding methods a satisfactory success shall have been obtained.

"In the case of carrying out the irrigation of the Marchfeld by running the water in a canal from the Danube at Kornenburg, it would appear possible, according to the foregoing data, to take the sewage in the trunk canal. The considerable cost, however, which this conduction would require, would be divided over an area of from 35,000 to 69,000 hectares. In spite of the increase of cost, the irrigation undertaking itself offers a correspondingly greater prospect of a profitable return by the introduction of the sewage. The careful study of such a particularly desirable plan is, therefore, the more earnestly recommended to the

Royal and Imperial Ministry of Agriculture, as it concerns the increase of productivity of an entire district. These studies should be also extended to the question whether this method of disposing of fecal matter was not opposed to some sanitary considerations, particularly in the case of a general silting up of the canal.

"On the right bank of the Danube, which for the most part lies too high, opportunity is lacking for an irrigation system upon a large scale. On the contrary, however, the plan for a model irrigation system appears highly commendable as incitement and instruction for the agricultural population. This could be arranged as an experimental station, which would not only have important local questions to solve for the future, but would also serve the science in general, in that it would be in position to determine the question of a profitable utilization of the city's sewage, as also its actual value by a thorough trial.

"From the standpoint of realizing a profit from the Vienna sewage for agricultural purposes, there is no occasion to raise any objection against the partly completed plan of the trunk-intercepting sewer.

"As in the future the handling of the sewage—for example, the erection of a pumping plant for raising the water from the sewers—is to be taken into account, it appears desirable to reserve the necessary area in the vicinity of the highway bridge in order at the proper time to be able to establish this plant and connections without difficulty."

Vienna, May 30th, 1894.

I. Result of the Measurement of the Flow of Waste Water in the Intercepting Sewers.

With the object of measuring the waste water flowing in these sewers, overflow weirs were built in them, and the quantity of flow was calculated from the depth of overflow.

These weirs were set up in the sewers close to their outlets into the Danube canal, and the readings of the depths of overflow were obtained during intervals of from three to six hours in four days and four nights, during the period from September 4th to 16th.

The results of these measurements and observations are set out in Table I, and in it are also the volumes of waste water discharge in the other sewers, estimated upon the basis of experience.

The table, furthermore, contains the estimate of the effect upon the quantity of flow of the rainfall occurring before and during the period of measurement, and also the stage of water in the Danube canal given occasionally.

The latter permit a conclusion concerning the ground water level of District II and partially also for Districts I, III and IX. During the entire time of gauging the ground water level was higher than the sole of several sewers in District II, and considerably higher than the sole of the Brigittenau intercepting sewer, which explains the actual discharge of this sewer (47 litres per second). Both the rainfall as well as the ground water carried off by the sewers exercised a considerable effect upon the volume of sewage during the time of observation.

As is seen by Table I, there will be tributary to the right and left main intercepting sewers, after their completion, a built-up area of 3,450 hectares with a population of 1,315,000 persons. This area was, at the time of gauging, furnishing 1,087 litres of sewage per second to the Vienna Danube canal. Each hectare of built-up area therefore contains an average of 381 people, and supplies, according to the results of the measurement, 71 litres of waste water daily to the sewers.

The consumption of public water, which is determined each day at the reservoir by measurement of the effluent, amounted at the time of the observations for sewage almost constantly to 73,400 cubic metres per day, or to 848 litres per second, while according to Appendix A the discharge from the sewers was 93,917 cubic metres per day, or 1,087 litres per second.

Leaving out of consideration the always considerable amount of public water which is used for sprinkling the streets and gardens, and which is mostly evaporated, the volume of water supplied upon the days stated amounts to only 78% of the quantity discharged by the sewers, therefore at least 22% of the calculation must be set down as water drawn from wells, and to ground water and rain water.

The results obtained agree, therefore, with the approximate measurements made by the City Engineer's office upon several occasions, at times of long drought and deep ground-water level, to determine the total amount of waste water discharged by the sewers, which is shown to be between 700 and 800 litres per second.

It follows from these statements that *both main intercepting sewers in the near future, under normal conditions, will hardly deliver a larger quantity than 1,000 litres of waste water per second.*

As further may be understood from Table I, the main trunk intercepting sewers are so designed that they will be able in the future to carry the computed volume of 4,779 litres per second from a population of 3,712,000, that is, from nearly three times the present number.

Should, therefore, works for gaining a revenue from the city's sewage be built, they must at first be constructed *for a constant sewage flow of 1,000 litres* per second, but consideration must be given to their extension to a capacity of 4,000 litres per second.

The flushing of the sewers will exert a considerable influence upon the value of the sewage, and consequently upon the possibility of obtaining any definite profitable return from it.

In the preparation of the plans for the trunk intercepting sewers special provision is made for flushing them, for at several points on the intercepting sewers flushing inlets are provided, through which water can be turned into the trunk intercepting sewers from the Danube canal. By these means the computed present volume of sewage of 1,000 litres per second experiences an increase to 4,000 litres per second, and one part of sewage is diluted by three parts of river water. During the flushing, therefore, a given amount of fertilizing ingredients will be carried in four times the ordinary quantity of water.

This disadvantage may be partially diminished at least if the municipal authorities cause the flushing of the intercepting sewers by river water to be done only at a fixed time of day, and for about three hours daily. As the cleanliness of the sewers under normal conditions can be maintained only by flushing daily, no objection should be raised against this method of operation.

II. Results of the Analysis and Valuation of Vienna Sewage.
(Prof. Dr. Meisslr and Chief Engineer Kohl.)

Samples of water were taken at different times of the day from the six sewers named in Appendix I, which carry about 71% of the total volume of Vienna water. The result of the chemically analytical investation and valuation made upon these water samples is shown in Table 2 in which is also stated the value of the excremental contents in propo.-tion to the number of inhabitants.

In explanation of the table the following will be noticed:

The direct investigations were made, as already stated, upon the contents of the sewers indicated in Table I by the item numbers 5, 7, 9, 10, 12 and 14, while in the next to the last line are placed the measured average values for the nine sewers carrying the remaining 29% of volume obtained from earlier inferences as well as results of differently conducted investigations.

The heading "b" shows how many kilograms of sediment are contained in 1,000 litres of water from the sewer. The considerable amount of sediment in the Alsbach (1.53 kilograms per 1,000 litres of sewer water) is attributed to the fact that the brook in its upper course runs through an unpaved channel, and therefore carries with it a good deal of earthy matter and solid, heavy materials, which are brought into the sewer in large quantities. Moreover, the districts lying adjacent to the Alsbach have no measured water supply—according to the heading "g" of Table 2 there are only 38 litres of sewage discharge per capita daily—on which account the sewage is naturally more concentrated than in other sewers.

The considerable amount of sediment in the two Cholera sewers (1.53 and 1.16 kilograms per 1,000 litres of sewer water) has its cause in the numerous factories connected to them, among which the tanneries, dye houses and the soap factories particularly deliver a large quantity of solid materials to the sewers.

On the other hand, the relatively small quantity of sediment in the Brigittenau, the Favorite and the Ring street intercepting sewers (0.32, [illegible] and [illegible] kilograms per 1,000 litres of sewer water) finds its explanation for the first two in the considerable quantity of ground water which these sewers were carrying at the time of taking the samples, and in the case of the last named in the large use of public water in the district tributary to it, as well as in the entire absence of sediment-bearing factory water.

The amounts of sediment are accordingly extraordinarily variable. According to the investigations made, they vary between 0.32 and 1.53 kilograms per 1,000 litres of sewer water; they are dependent upon the fall of the sewer, the nature of the pavement of the street (whether block or stone), and to [illegible] the extent of sprinkling, etc.

It has been observed in other places that the quantity of suspended material in the sewage is far greater in the winter months than in the summer months, and it is true that the higher value is mainly due to the increase in [illegible] matter. The tests concerning the amount of suspended matter also show extraordinary differences. The Frankfort sewage contains [illegible] to [illegible] kilograms per 1,000 litres of water [illegible] the Berlin sewage [illegible] to [illegible] kilograms of suspended matter.

The average quantity of sediment transported by all the Vienna sewers [illegible]

The [illegible] sewer flow of 93,917 [illegible] matter per [illegible] kilograms, which, [illegible] com- [illegible] per day [illegible] com- [illegible]

[illegible] ingredi- [illegible] very variable, [illegible]

	5	7	9	10	12	14
	Alsbach and Weighringer Bach	Ringstreet intercepting sewer	Left Cholera sewer	Right Cholera sewer	Favorite intercepting sewer	Brigattenan intercepting sewer
(a) Composition of the sediment,						
Nitrogen, - %	2.64	3.11	2.75	2.17	2.87	3.62
Phosphates, - %	1.34	1.56	2.07	1.27	1.70	1.90
Potash, - - %	1.02	0.63	0.52	0.93	0.94	1.22
(b) Composition of the sewage after separation of the sediment.						
In each 1000 litres,						
Nitrogen, - - gr.	352	179	197	160	160	84
Phosphates, - gr.	73	30	26	20	25	20
Potash, - - gr.	203	100	136	120	92	85

CHEMICAL COMPOSITION OF VIENNA SEWAGE.

The average of the foregoing analysis of sewage gives the proportion of nitrogen to phosphates to potash as 616:100:421, while in stable manure it is 167:100:200, and in artificial fertilizer it is ordinarily taken as 50:100:150.

For the valuation of the sewage and its sediment we can start either from the value of single plant foods in the artificial fertilizers, or from its value in stable manure and stable liquid.

By the first calculation a very high value is naturally given on account of the concentrated form of the fertilizer, which for the case at hand is not applicable.

In the artificial fertilizers mentioned the price of the plant food can be taken in similar manner as in the sewage:

*Nitrogen........................	55 kr. per kilogram.
Phosphate........................	18 kr. " "
Potash........................	20 kr. " "

Upon the basis of these unit prices result the values given in the first sections of columns d, e, h and i of table 2, for the sediment and sewage carried by the different sewers.

The practical value of the sewage is obtained much more closely if comparison is made with the prices of plant foods in stable manure and its liquor.

One hundred kilograms of stable manure delivered at the Marchfeld and spread out upon the field cost 10-20 kr., at the most, perhaps 30 kr.; experience has shown that at a higher price the use of the stable manure becomes unprofitable.

At the highest allowable price of 30 kr. for 100 kilograms of stable manure and an average composition of manure of

0.5% nitrogen,
0.3% phosphates and
0.6% potash,

and with a value ration of nitrogen: phosphates: potash = 3: 1: 1, in the manure, or on account of greater ease of separation of the phosphates—of nitrogen: phosphates: potash = 6:3:2, in the liquor, the value is calculated,

	of nitrogen	37.5	kr.
	" phosphate	12.5	"
	" potash	12.5	"
and	" nitrogen	37.5	"
	" phosphate	18.75	"
	" potash	12.5	"

At a price of 10 kr. per 100 kilograms of stable manure these values are reduced to one-third. It is contended that the sewage has a composition much inferior to that of even a moderately good stable manure, because the relative proportion of the three plant foods (nitrogen, phosphates and potash) is a very unfavorable one, and in consequence of which the sewage is to be regarded actually as merely a partially nitrogenous fertilizer. To take as a basis for the valuation of the sewage a higher figure than that corresponding to a stable manure price of 10 kr. per 100 kilograms, does not, therefore, appear to be justified; this gives,

	Nitrogen,	12.5 kr.
	Phosphates,	4.17 kr.
	Potash,	4.17 kr.
and	Nitrogen,	12.5 kr.
	Phosphates,	6.25 kr.
	Potash,	4.17 kr.

The calculations upon sewage made upon this basis gives the values quoted in the section of columns d, e, h and i, table 2.

The relatively high value of the sewage test from the Ring street sewer (column i) can only be attributed to some chance and cannot be taken as a standard. The values of the sewage in the remaining sewers show special or striking differences, except as their contents are affected by the previously discussed special conditions.

As a final result we have an average value of 3.05 kr. or 13.43 kr. for 1,000 litres of sewage free from sediment, of 0.46 fl. or 2.03 fl. for 1,000 kilograms of sediment, and of 3.5 kr. or 15.7 kr. per cubic meter for the uncleared sewage, compared with stable manure and artificial fertilizer respectively.

If for the determination of value of the daily flow of 93,917 cubic meters of sewage, the price of artificial fertilizer is taken for a basis, the sewer water (table 2, column k) has a value of 12,613 fl. per day, and the sediment (table 2, column f) has a value of 2.078 fl. per day, and the uncleared sewage, therefore, has a value of 14,691 fl. per day.

If, however, the purchase price of stable manure is taken as a basis (10 kr. per meter centner delivered at the Marchfeld) the value reduces
to sewer water (table 2, column k).................... 2,864 ft. pr. day
sediment (table 2, column f).................... 471 ft. pr. day

Therefore of the uncleared sewage............. 3,335 ft. pr. day

Finally, computed per head of population occupying the sewer system district and per year, the sewage has a total value of 4.08 compared with artificial fertilizers, and of 0.92 fl. compared with stable manure.

This difference is quite considerable. It has been previously shown that the valuation according to the high prices of similarly named plant foods in the artificial fertilizer is not permissible, therefore, to render possible a correct comparison, avoiding all illusions, the lower of the foregoing figures are to be taken as the basis.

It would not be entirely unjustified in the valuation of the sewage, to take into account only its nitrogenous ingredient. In this case, then, the value of the sewage, the above named price for the kilogram of nitrogen in stable manure taken as the basis, would be placed at an average of 2.36 kr. per 100 litres of clear sewage.

Finally it should be mentioned that the foregoing average figures for the composition and value of Vienna sewage, while as close to reality as possible, can still undergo a change because on one side the examination for volume and composition of sewage had to be confined to the trunk sewers, and on the other the investigations could be made only during a part of the year. However, not only the results obtained in similar cases elsewhere, but also the circumstance that the sewage examined formed by far the largest portion of the total, and that different kinds of weather prevailed during the gauging and sampling, make it appear that the figures obtained cannot be far from the actual yearly average for all sewage.

It is hereby recommended to make continuous measurements for at least a year of the water flowing in the trunk sewers, and to make automatically simultaneous tests to obtain the average.

III. Profitable Return from Vienna Sewage, when used for Agricultural Purposes.

(4 Regierungsrath Markus.)

* * * * * * * * * * *

A. Profitable Use of Sewer Water by Sedimentation.

(Regierungsrath Markus and Chief Engineer J. Kohl.)

As was seen in Appendix II, 102,370 kilograms of sediment are daily discharged by the Vienna sewers; this at a price of 0.46 florins per 100 kilograms, computed from comparison with the cost of stable manure, possesses a theoretical value of 471 florins per day.

If this figure is compared with the value, 2,864 florins, of the daily flow of sewage, it follows that the greater portion of the agriculturally valuable material is contained in water, and that the useful value of the solid material in the sewage is that of the material in solution as 1:6.

Now, however, arises a condition which tends to considerably reduce the computed value of the sediment.

The quantities of sediment given in table 2, were actually obtained in the laboratory by filtration of the sewage, also by a process concerning the application of which to a daily quantity of ninety-four million litres no report can be made. The extraction of the sediment by chemical precipitation as is done at Frankfort-on-the-Main, Wiesbaden, Essen, Dartmund, Halle, etc., has, as is known, to the present obtained few really satisfactory results in regard to general agriculture, while the deposit in the settling basins is damaged and depreciated in value by the presence of matters undesirable for agricultural purposes, such as clay, chalk and iron oxide.

The experiments of Dr. Lepsius in Frankfort from 1888 to 1891 have proved that the clarification of sewage by purely mechanical methods is only a little behind other processes. The total yearly expense of 70,000 marks for chemical precipitation in Frankfort is, however, justified by the fact that the deposit owing to the above mentioned materials and to drying becomes transportable.

Should the necessary settling basins for the mechanical clarification of the sewage in Vienna not demand too great extension and thereby lead to an excessive increase of cost for plant and operating expenses, the process must be restricted merely to the diminution of velocity of flow with the object of obtaining the heavy precipitable matters.

The volume of sediment so obtained would in any case be actually smaller than that stated in table 2, and for the most part be composed of the heavy mineral ingredients, which possess either only a very little fertilizing value or none at all. Quantity and quality of the sediment experience, therefore, a considerable reduction in this one practicable method of sedimentation. Thus, for example, in Berlin, about 9,500 cubic metres of heavy matter consisting mainly of sand, paper, rags and coffee grounds, are annually discharged from the pumping stations and the sewers. This mass is 1/4700 of the total volume of the sewage

The value of the sediment computed from analysis as 0.13 florins per capita yearly would by sedimentation of all the sewage experience a considerable reduction.

As a measure of the cost of clarification as it is carried on by the several municipalities, it may be noted that, including an interest charge of 4% per capita, yearly, upon the capital invested, it amounts to

in Frankfort,	1.22	marks	=	0.73	florins.
Wiesbaden,	0.68	"	=	0.41	"
Halle,	0.83	"	=	0.50	"
Essen,	1.00	"	=	0.60	"

From this it appears that the expenses of sedimentation are quite considerable, and that even with the most practicable simplification of plant they will always be higher than the value of the sediment obtained, and particularly so where on account of sanitary reasons the removal of the clarification plant from the neighborhood of the city is demanded. In such a case the establishment must be removed to a considerable distance and the sewage supplied to it there. Moreover, the nature of the sediment so obtained demands still further treatment in order to bring it into a condition permitting its transportation to further distances.

These conditions relating to the cost of extraction on the one hand and the fact established by already existing settling plants on the other, that the deposit formed in the settling basins is removed by the farmers either not at all or only to a very slight extent, even when they can obtain it without cost, do not speak much in favor of sedimentation.

Numerous privies still exist in the suburban districts of Vienna, and their contents are generally buried or emptied into the sewers, although a cubic metre of it contains 4.26 kilograms of nitrogen, 1.84 kilograms of phosphates, and 1.69 kilograms of potash, and, therefore, in comparison with stable manure, possesses a value of 68 kreutzers.

The applicability and value of a fertilizer depend not only upon its theoretically computed value, but first and foremost upon its form and the relative proportions of the plant food contained in it.

In view of all these circumstances the undertaking of even partial sedimentation of the sewage cannot be advised under present known conditions of operation.

B. Profitable Use of Sewage by Irrigation with it Undiluted or Diluted in general.

(Regierungsrath Markus.)

A utilization of sewage in that manner can in general be made on the level tracts upon the right bank as well as upon the left bank of the Danube.

1. Upon the right bank.

The ground upon the right bank of the Danube lies very unfavorable for the conduction of sewage.

2. On the left bank.

In whatever manner the utilization is made, whether by filtration with undiluted sewage, or by irrigation with diluted sewage, the plans for collecting the sewage near the Stadlau bridge and for carrying it across the Danube will be similar, while the mixing of the sewage with river water can first be done on the further side of the stream.

The method and manner of transferring the sewage to the other bank varies, however, as this can be accomplished either by means of a pressure pipe above ground and a bridge, or by laying an inverted siphon under the bottom of the Danube. The locality in which both sewage and river water are used can also be varied according to the proportion of extension given the irrigation district.

There are, therefore, two cases to be discussed:

(a) Carrying the sewage over above the Danube and conducting it into the Marchfeld irrigating canals at Gerasdorf.

(b) Conducting the sewage across under the Danube, and thence into the Marchfeld irrigating canals at Gerasdorf.

* * * * * * * * * *

The total cost per cubic meter for fixed charges and operating amount therefor to 1.00 kr., and for operating expenses only to 0.42 kr., against the value of 3.5 kr. per cubic meter given in Appendix II.

In Berlin the cost of the pumping alone amounts to 0.114 marks or 0.67 kr. per cubic meter of sewage with the normal pressure head to the filtration fields of 20 to 25 meters.

* * * * * * * * * *

Total cost for carrying the sewage to Gerasdorf (lower level) by means of a siphon under the Danube river, 2,580,000 fl.

* * * * * * * * * *

With a volume of 20,736,000 cubic meters of sewage pumped during the working season of 8 months, the total cost of handling amounts to 1.11 kr. and the cost of operating proper to 0.41 kr. per cubic meter.

* * * * * * * * * *

C. Irrigation with Undiluted Sewage on the Left Bank of the Danube.

(Regierungsrath Edward Markus.)

Pure, broad irrigation presents to the agricultural point of view the picture of excessive extravagance. It gives no natural and particularly no agriculturally useful fertilizer with a compound of the unfavorable proportions of sewage. How high the actual surplus application of fertilizer amounts to in the case of pure, broad irrigation filtration is shown by Grandke in the following interesting figures:

An ordinary application of stable manure for farming purposes amounts to 480-600 centner (24-30 loads) per hectare, a heavy application to 800-1000 centner (40-50 loads). A hectare of broad irrigated land receives on the contrary a fertilization equal to eleven times that of an application and seven times that of a heavy one, and that, moreover, every year. A farmer who gives his farm a full fertilization only every third year would be able to regularly and abundantly fertilize with nitrogen about twenty-one times as large a surface. With potash and phosphates the fertilization amounts to three or four times a heavy application each year.

It is assumed from analogy with the Berlin irrigation fields that 14,000 cubic meters of sewage will be taken by each hectare per year in irrigation, and that the Vienna irrigation fields can have an extent of 2,450 hectares. (Berlin has 3,230 hectares.)

* * * * * * * * * *

Total cost of irrigating a surface of 2,450 hectares is 6,785,000 fl. or 2,769 florins per hectare.

* * * * * * * * * *

In the foregoing estimate it was, however, assumed that the surface of 2,450 hectares would be subjected to irrigation throughout its whole extent. The extent of land available is likely to be very small at first, and only obtain an extension in case the success of the irrigation becomes pronounced.

In this connection the development of the irrigation fields in Gennevilliers at Paris is very instructive, although these, owing to the market facilities offered by Paris, were without doubt in a particularly favored place.

These irrigation fields measure:

in 1869,	6 hectares,
in 1880,	450 "
in 1888,	715 "
in 1890,	800 "

As it, therefore, required a period of 21 years in Gennevilliers to bring the area to 800 hectares, there is no prospect that this extension will be accomplished in the Marchfeld.

In spite of this the system for collecting, pumping and conducting the sewage must be constructed for handling the before mentioned volume of 1,000 litres per second.

The costs of the project remain to a certain degree independent of the extent of irrigation practised. Unlimited diminution is possible only in the operating expenses.

A slow development of the irrigation farming, or if it remains below the area of 2,450 hectares, would, therefore, impose an exceedingly heavy additional burden upon the first irrigated property. A guarantee that the irrigation farming will quickly attain its extension or that the above computed extent of 2,450 hectares will be even only approximately reached, is not given.

These figures prove that the carrying out of a broad irrigation purely is not possible and that there is scarcely anything to be said concerning a profitable utilization of the sewage in sense of a definite return upon the capital outlay.

In this place it may be allowed to give some data obtained from a ten years' operation of the Berlin irrigation fields as well as from two French systems of this nature.

As is stated in the report of the Berlin city irrigation works, the irrigation farms during the administration year of 1891-2 had a surplus of receipts over expenses of 243,000 marks. or an interest of 1.423% upon the capital outlay. In this connection it should, however, be remarked that in the capital outlay for the irrigation farms the cost of acquiring the land for pumping stations, for their construction and for laying the pressure pipes up to the irrigation farms, is not included. In similar manner the expenses of operating the pumping stations (computed at 671,561 marks for the year 1891-2), are set down as a charge against the irrigation farms, but is charged against the sewerage of the city. Were all these expenses charged to the sewage farms they must have been unremunerative.

Closer information concerning the profitableness of the individual sewage farms is contained in the report of the Berlin City Councillor Marggraff upon "The Sewerage of Berlin," published with the proceedings of the Seventh International Congress of Hygienne and Demography in London, 1891.

According to that there were up to that time four farm systems in complete operation. From these was obtained during the municipal year 1890-1, including the purchase price of the farms, their adaptation, grading and draining, a dividend as follows viz.:

1. From the farms of Osdorf........................	0.049%
2. From the farms of Grossbeeren,....................	2.56 %
3. From the farms of Falkenberg......................	3.29 %
4. From the farms of Malchow.......................	2.32 %

Even in these figures also the cost of the system for bringing the sewage to the farms as well as the cost of the maintenance and operation of this system are not included.

According to the contents of the municipal report of the City of Berlin for the year 1892-3 the profitableness of the sewage farms during the period had considerably diminished and amounted to:

1.	The Osdorf farm	=0.21%
2.	" Grossbeeren farm	—0.80%
3.	" Falkenberg "	+2.26%
4.	" Malchow "	+0.92%
5.	" Blankenfelde "	—2.73%

Essentially more favorable are the conditions at the sewage farms at Gennevilliers near Paris, which in 1890 had attained the size of 800 hectares. They are in excellent condition and produce the finest kind of products. The increased profit from the ground is computed to be 800 francs per hectare, and its selling value is estimated at from 10,000 to 20,000 francs, and may run up to even 22,000 francs per hectare.

The City of Paris bought the land at the beginning and afterwards sold it at a considerable profit.

The population of Gennevilliers increased 80% between 1866 and 1886 and between the latter date and 1891 grew from 4,443 to 5,837. The conditions as to health have not suffered in the least, notwithstanding the ground water used for drinking purposes is the sewage which has been filtered through the soil. During the Cholera epidemic in the summer of 1892, the irrigation was a little interrupted there, as in Berlin, where the conditions on account of the slight permeability and receptiveness of the soil are not by any means so favorable.

At Rheims in 1890 the sewage farming was conducted by the "Compagine des Eaux Vannes." The surface available for irrigation amounts to 520 hectares of which the city of Rheims laid out 160 hectares, while the remainder was purchased by the Company.

A portion of this area receives the sewage by gravity, the remainder (Domaine Baslieux) by the pumping of a 110-horse-power engine. In 1891 280 hectares were cultivated with sugar beets under complete irrigation.

After the conclusion of the agricultural experiment the company leased all of the irrigated land to a farming company at the following average yearly prices per hectare, viz.:

100 and 200 francs for the first two years,
200 " " " " following eight years.
225 " " " " " ten "
250 " " " " " sixteen "

The instance just quoted proves that the success of sewage farming can be very different, depending upon the local conditions.

Climatically Paris and Rheims are considerably more favorable situated than Vienna and Berlin, a point that should not be lost sight of. Moreover, it is not proved that the system of limited area in Gennevilliers would be able to return such large profits if it were given an extension of area to 2,000-3,000 hectares.

Finally, it must not remain unnoticed that throughout France, where, in consequence of a rational irrigation (not filtration with city sewage) a favorable climate, special industry of the inhabitants, an assured market and a rational culture, the cultivation of certain kinds of plants, or the development of a special culture method, have become particularly profitable, the price of the land, as a result of its increased earning capacity, has experienced a very considerable rise in value.

As illustration, the ground in the vicinity of Marseilles, irrigated with the water from the sewers, costs 15,000 to 20,000 francs per hectare; that adjoining the canals of Carpentras, Isle and Cebedan, also in the parishes of Chateaurenard St. Remy and Graveson, an average of 4,000 to 5,000 francs per hectare (formerly 700 francs), while the areas watered by the Canal du Verdon have risen in price to five and ten times their earlier value.

Exactly similar conditions have been shown, also, in the irrigated portions of Lombardy and Venice.

Moreover, were the lease profits obtained at Rheims, running from 100 to 250 francs, capitalized at an interest at 4%, there results a ground value of from 2,500 to 6,250 francs (1,200 to 3,000 florins) per hectare, which is not much higher than that quoted above for well-watered and thickly cultivated lands in the departments of Bouches du Rhone and Vauclose, although remaining far behind the value of Gennevilliers.

Against the above quoted prices for land there is, in case of the introduction of sewage farming into the Marchfeld, a charge per hectare in round numbers of 2,800 florins, if the full area of 2,450 hectares is utilized and of 4,500 florins in round numbers if the irrigation is limited to 1,000 hectares.

In view of all the foregoing circumstances the construction of an irrigation system with undiluted sewage cannot, under the given conditions, be recommended.

D. Irrigation with Diluted Sewage on the Left Bank of the Danube.

(Regierungsrath Markus.)

It is very difficult at best to properly establish a rational utilization of diluted sewage.

By a good average harvest there is, according to Heiden, taken from the ground, the nitrogen of 10 persons, the phosphates of 20 and the potash of 50. With the sewage from Vienna and an uninterrupted irrigation, an area of 131,500 hectares can, therefore, be abundantly supplied with nitrogenous fertilizer if no account is taken of the unavoidable loss by decomposition of the sewage in the conduits leading to the place of use. To be sure the necessary amounts of phosphates and potash lacking must be supplied in some other way.

Fertilization with diluted sewage is subject to the same limitations as a simple irrigation, and, therefore, to begin with, is dependent upon duration of the profitable period of vegetation, and the precipitation. The duration of this irrigation can be set down as from six to eight months each year upon the average. The Vienna sewage would, therefore, during this length of time be able to cover 65,000 to 86,000 hectares upon a nitrogen basis.

E. Concerning the Profit to be Derived from Introducing the Vienna Sewage into the Trunk Canal of the Proposed Marchfeld Irrigation.

(Freiherr von Pirquet, Wilh. Wodicka.)

If it is worth while to discuss the profitableness of this future introduction, it appears to be of the first importance to consider the question squarely, whether, as some of the members of the Sub-Committee have feared, a large part of the fertilizing material contained in the sewage would not be lost during its long passage through the sewers and canals. The authors do not share these fears, and found their opinions upon the teachings of scientific results and practical experiences.

The principal action is accomplished in the same manner as the so-called "self-purification of rivers"; this is that not only are the harmful organic substances in the water of a river diluted or deposited, but also undergo a particular chemical decomposition, so that after a relatively short flow they lose their harmful character. This process of change does not, however, depreciate the fertilizer, but the contrary.

By this only a change of harmful organic substances to harmless organic materials has been accomplished; the value and quality of the fertilizing materials are not injured by this change.

A portion of the plant food which is contained in the sewage, is lost after a long flow in the rivers, either by being carried into the underground or by being taken up by vegetable and animal life. This loss is, however, in our case exceptionally small.

* * * * * * * * * *

As a standard practical example of an irrigation with strongly diluted city sewage, which still, even to great distances, fertilizes the soil in a conspicuous manner, the Bettabia canal in Milan can be mentioned. Regierungsrath Markus gives some detailed data concerning it in his instructive book, "Improvements in Italy," pp. 85-87; it dates from the twelfth century, carries as high as 3,000 litres of river water per second, including about 180 litres of the so-called Milan house water. The effect upon the vegetation is a conspicuously favorable one, and no harmful effect in sanitary matters has arisen from the system to this day.

These statements have found full confirmation and amplification in the information which Vittoria Salvini has given. We give here his letter of April 6, 1894, to Freiherr v. Pirquet, nearly at full length, on account of its importance.

"This canal carries three to four cubic meters of water, and is the one which receives a large part, about three-fourths of the Milan sewage, and carries it for distribution below Milan to a distance of twenty kilometers.

"From the experiences which we, who are at the same time engineers and farmers, have had, we can state that the loss of fertilizing constituents, even at a distance of twenty kilometers, is an entirely insignificant one. It would be an error to believe that the farmers who live twenty kilometers down the stream receive for irrigation only clear water from the Vettabia; the water in the canal may not be as rich in fertilizing materials as directly in front of the doors of the city, but it is still far richer than the water from any other canal. In order to prove to you what I state, I am in a position to state that for tracts of ground which are irrigated with water from the Vettabia canal the lease price is about fifty francs per hectare higher, as well for tracts twenty kilometers distant as for that on the immediate outskirts, than for land otherwise irrigated.

"For the purpose of keeping the manuring contents in the current of the stream undiminished, it is necessary to give the canal the strongest possible fall; our Vittabia has a fall of 0.70% up. Only relatively small amounts of fertilizing material and sediment are at first wasted in the bed in a newly built canal: after a few months the bottom and sides are covered with a layer of manuring material, which form an actual crust, and which in consequence prevent any further escape. We, at this locality, in order to prevent the accumulation of heavy matters and at the same time to keep the canal water throughout its course at the same fertilizing strength as far as possible, place laborers in the canal from time to time who stir up the coating of slime on the bottom, so that it is carried along by the water.

"If the Vettabia water, as I have mentioned, brings an equally high price twenty kilometers below Milan, the cause lies probably in this fact that commercial fertilizers cannot be so easily obtained for ground at a distance from Milan, and the fertilizing water becomes that much more valuable. But the equality of price after a long experience proves that the contents of the water suffer no considerable loss during the long flow."

Construction of the Marchfeld Irrigation Project for an Area of 69,000 hectares.

The cost of the transfer system increased by the capitalized operating expenses (estimated for eight months) according to the computation previously given amount to 63 florins per hectare.

Against this outlay of capital there should be computed the value of the sewage, which, having been sufficiently diluted with water, is brought to the plain in a condition favorable for taking by the plants.

One must, therefore—

Firstly. Take into account a loss of value in consequence of the dilution of the sewage by rain and by the flushing of the intercepting sewers. Probably each intercepting sewer may be flushed for a maximum of three hours daily. As by this the sewage is only diluted and not rendered entirely valueless, we will charge the remnant to rain and contingencies and so take three hours, i. e., one eighth or 12.5%, into the computation as loss in value.

Secondly. Take account of those even if small losses reducing the manuring material which occur during the flow through the canal or arise from the fact that in irrigating the ground the fertilizing matter is not entirely absorbed, but a portion passes into the sub-soil and so is lost to vegetation.

In an irrigation the suspended matters are almost entirely retained by the ground; the taking up of the separated matter depends, however, upon the absorptive powers of the ground and upon the strength of the irrigation. In this connection it must be mentioned that the public report of the Expert Commission already mentioned says the southern Marchfeld district, which forms two-thirds of the entire plain, consists of a sandy loam, a tenacious soil, whose absorptive power is doubtless very high, and that the proposed irrigation is actually only a moistening one, a surplus of water not being in command.

Now, it is known that during the summer in a tenacious soil only 5% to 6% of the rainfall penetrates to the lower depths, in a light soil as high as 23%, while the remainder is evaporated and taken up by plants.

We compute, therefore, these losses of the second category as 15%.

If we add the above estimated loss of 12.5% to this the total loss figures out 27.5%, or in round numbers 30%; with this exceptation a sufficiently cautious estimate can be made.

Upon the basis of the computations made in reports I and II—with a flow of one cubic meter per second, and with a valuation of 3.5 to 15 7 kreutzers per cubic meter—the value of the sewage flowing from the trunk sewers and for 240 days amounts to, in round numbers, 700,000 to 3.200.000 florins.

If we take account of the above computed 30% reduction we have the value of the fertilizer available for vegetation reaching the Marchfeld in the course of the year in round numbers from 490,000 to 2,100,000 florins.

This amount divided among 6,900 hectares gives a yearly manuring value of from 7.12 to 32.13 florins per hectare, which, therefore, represents the basis for the calculation of the profit upon the capital outlay for the conducting system.

The capital outlay of 63 florins per hectare for the conducting system would, therefore, pay an interest of 7.12 florins to 32.03 florins; that is, from 11% to 50%.

* * * * * * * * * *

IV. Concerning the profitable use of sewage under the Hobohm plan of loading the sewage and carrying it (after a preliminary partial sedimentation) in boats upon a canal crossing the Marchfeld in the direction of Gross-Enzersdorf-Augern.

* * * * * * * * * *

The Hobohm scheme does not seem practical, and would by its adoption not be able to bring about a profitable utilization of the Vienna sewage.

TABLE GIVING VOLUME OF SEWAGE IN THE MAIN INTERCEPTING SEWERS ALONG THE DANUBE CANAL.

Number.	DISTRICT.	MAIN INTERCEPTING SEWERS.									TOTAL I AND II VOLUME.		BASIS FOR FUTURE PROJECT.	
		AT PRESENT.						IN FUTURE.						
					VOLUME OF SEWAGE				Volume of Sewage					
		Area Hectares	Inhabitants Thousands.	Inhabitants per Hectire.	Litres per Second.	Cubic Metres per Day.	Litres per Capita per Day.	Inhabitants, Thousands.	Litres per Second.	Cubic Metres per Day.	Litres per Second.	Cubic Metres per Day.	Inhabitants. Thousands.	Volume Litres per Second.
		RIGHT INTERCEPTING SEWER.												
1	Schreiber Bach	20	5.^{2}	260	3	259	50	.....	.....	.....	3	259	29	35
2	Nessel Bach	22	5.^{6}	255	4	346	62	.....	.....	.....	4	346	52	72
3	Krotten U Erbsen-Bach	38	7.^{9}	208	6	518	65	(08^{1})	1	86	7	604	154	209
4	Wolfgraben and Spittelanergasse	107	22.^{15}	207	20	1.728	78	.....	.....	.....	20	1.728	90	141
5	Als-Bach with Währinger-Bach	509	202.^{60}	398	89	7.690	38	(3 7^{2})	4	346	93	8.036	417	533
6	Pramer to Maria Therestagasse	71	31.^{70}	446	30	2.592	82	.....	.....	.....	30	2.592	38	47
7	Ringstrasse	114	36.^{19}	317	53	4.579	126	.....	.....	.....	53	4.579	59	75
8	Salzgries Rothenthurm Strasse, Postgasse	118	41.^{30}	350	40	3.456	83	.....	.....	.....	40	3.456	61	77
9	Linker Cholera Canal with Ottakringer-Bach	839	388.^{50}	463	232	20.045	52	6.2^{3}	6	518	238	20.563	900	1147
10	Right Cholera Canal	765	256.^{16}	335	295	25.488	99	14.1^{4}	14	1210	309	26.698	939	1207
11	Weissgärberlände Schlachthausgasse	254	76.^{00}	299	62	5.357	70	.....	.....	.....	62	5.357	176	209
12	Favoritener Intercepting Sewer	162	61.^{00}	376	61	5.270	86	.....	.....	.....	61	5.270	261	336
13	Erdberger Mais Simmering	80	25.^{80}	322	18	1.555	60	.....	.....	.....	18	1.555	148	194
	Total Right Intercepting Sewer	3099	1.160.10	374	913	78.883	68	24^{8}	25	2160	938	81.043	3.324	4282
		LEFT INTERCEPTING SEWER.												
14	Brigittenauer Intercepting Sewer	79	29.^{60}	375	47	4061	137	.....	.....	.....	47	4.061	160	204
15	Von der Rembrandt Strasse to Stadläuerbrücke	272	125.^{30}	461	127	10.973	87	.....	.....	.....	127	10.973	228	293
	Total left Intercepting Sewer	351	154.^{90}	441	174	15.034	97	.....	.....	.....	174	15.034	388	497
	Total Right and Left Intercepting Sewers	3.450	1.315.^{00}	381	1.087	93.917	71	24.8	25	2,160	1112	96.077	3712	4779

NOTES.

The figures in heavy type indicate volumes of sewage measured by a weir and from which samples were taken for analysis. The gauging was done September 4, 16, 1893. The volumes from the other Sewers were estimated. Much ground water was carried during the gauging. The consumption of public water during this time was 73.400 cubic metres per day or ·848 litres per second.

RAINFALL BEFORE AND DURING GAUGING.

24 August 2.3 m m.
25 August 0.1 m m.
25 August 0.6 m m.
2 September 1.5 m m.
3 September 8.1 m m.
8 September 0.2 m m.
9 September 1.7 m m.

STAGE OF WATER IN THE DANUBE.

From	Average
6 to 12 August	+0.39
13 to 19 August	—0.14
20 to 26 August	—0.35
27 Aug. to Sept. 2	—0.80
3 September	—0.80
5 September	—0.15
6 September	—0.05
8 September	—0.20
10 September	—0.55
11 September	—0.35
12 September	—0.25
16 September	—0.60

TABLE SHOWING AMOUNT AND VALUE OF SEWAGE IN THE MAIN INTERCEPTING SEWERS FROM CHEMICAL TESTS BY DR. E. MEISS.

Number in table No. 1.	DISTRICT	SEDIMENT									LIQUID						
		A	B	C	D		E		F		G	H		I		K	
		Meter Centner per day	Kilogramms per 1000 Littes of Sewage	Kilogramms per 1000 Inhabitants per day	Value per 1000 Kilogramms		Value per 1000 Inhabitants per day		Total Value per day		Cubic metres per 1000 Inhabitants per day	Value per 1000 liters = 1003 Kilogramms		Value per 1000 Inhabitants per day		Total Value per day	
					In comparison with artificial fertilizer	In comparison with stable manure	In comparison with artificial fertilizer	In comparison with stable manure	In comparison with artificial fertilizer	In comparison with stable manure		In comparison with artificial fertilizer	In comparison with stable manure	In comparison with artificial fertilizer	In comparison with stable manure	In comparison with artificial fertilizer	In comparison with stable manure
					GULDEN							KREUZER		GULDEN			
5	Alsbach and Wahringer Bach	117.7	1.53	58	1.89	0.43	1.10	0.25	222	51	38.4	24.7	5.7	9.38	2.16	1899.43	438.33
7	Intercepting sewer on the Ringstasse	17.4	0.38	48	2.11	0.48	1.02	0.22	37	8	126.5	12.4	2.8	15.70	3.54	566.80	128.21
	Left Choleracanal with with Ottakringer Bach	270.6	1.35	70	1.98	0.45	1.38	0.31	536	122	51.6	14.0	3.2	7.22	1.65	2806.30	641.44
10	Right Choleracanal	295.7	1.16	115	1.60	0.36	1.85	0.41	473	106	99.5	11.7	2.6	11.64	2.59	2982.10	662.69
12	Faroritener Intercepting sewer	20.0	0.38	35	2.06	0.47	0.67	0.15	41	9	86.4	11.1	2.5	9.44	2.07	584.97	131.75
14	Brigittenauer intercepting sewer	13.0	0.32	44	2.57	0.58	1.11	0.27	33	8	137.2	6.7	1.5	9.19	2.07	272.10	60.92
1.2.3 4.6.8 11.13	Total from other sewer in table 1	289.3	1.08	85	2.54	0.58	2.16	0.49	736	167	78.6	13.1	3.0	10.27	2.35	3500.30	800.66
1–15	All existing Vienna sewers average	1023.7	1.09	78	2.03	0.46	1.58	0.36	2078	471	71.4	13.43	3.05	9.59	2.18	12613.00	2864.00

THE PRESIDENT: Is it the desire of the members to take up the Captain's paper for discussion now? or perhaps it will be better to go on with the papers from this committee and after they are all regularly presented, the discussion can take place.

The next paper from the Committee on Sewerage and Sanitation, is by Mr. Kenneth Allen, Principal Assistant Engineer of the Sewerage Commission of Baltimore, on The Sewerage of Baltimore. It gives me pleasure to introduce Mr. Allen.

MR. ALLEN: I am sorry I have not some large maps and diagrams to put on the wall to illustrate this a little better, but I have some plates which were printed in our report last year, and which can be handed around, and which need not be returned.

THE SEWERAGE OF BALTIMORE.

(By Kenneth Allen, Baltimore, Md.)

Strictly speaking, Baltimore has no sewerage system, although the city has spent in the past over $4,000,000 in the construction of storm-water drains and there are many private sewers.

The city has suffered in consequence of the lack of proper sewerage for many years. I do not mean by this that the death rate is excessive—it is in the neighborhood of 19 per 1,000. But the use of cesspools is a detriment to property, the want of subdrainage in the business districts retards improvements, the use of gutters for wash water is offensive to those unaccustomed to it as well as a nuisance to all when obstructed by ice in the winter, and then there is no question but that the introduction of a proper system of sewerage would so improve the general sanitary condition of the town as to lower the death rate by at least one or two points. Dr. John S. Fulton, Secretary of the Maryland State Board of Health, estimates that with a population of 1,000,000, 373 lives would be saved annually by the consequent reduction in typhoid mortality alone.

When it is realized that such conditions exist to-day in a city of over half a million inhabitants; that of all our large cities New Orleans is the only other one remaining without sewerage facilities, while a beginning has already been made there in that direction; and when we remember that for the past 40 years the City of Baltimore has had the matter under discussion—we must admit that the time is ripe for a change. It is believed that the citizens realize this fact and will, before long, take active measures to prosecute the work.

Before speaking of the proposed system as outlined by the Sewerage Commission, I wish to state briefly the situation to-day.

In the first place, cesspools are almost universally used by rich and poor, great reliance being placed upon seapage into the soil to carry off the liquids. Of the remainder, some 50,000 gallons are removed daily by odorless excavators at a price of $2.50 per load of 200 gallons, and are taken to one of the two wharves designated for the purpose. Here they are delivered to a contractor for 25c a load and dumped into a barge holding, generally, 450 loads, or nearly 100,000 gallons. It is then conveyed in the barge by a tug to farming lands situated some 8 or 10 miles below the city, where it is sold to farmers or utilized on farm lands owned by the contractor.

It is pumped from the barge, by powerful steam pumps carried on a special pump barge, into large pits dug by the farmer. These vary in size, but average, perhaps, 30′x100′x5′, and will hold about a barge-load each. The farmer pays for this $1.67 per 1,000 gallons, or something over $100 a load, and there is no trouble in disposing of something over 12 million gallons a year at this price. The sludge left in the scow is shoveled into carts and taken by the farmer.

The liquid portion, or "soup," is bailed from the pit into tank carts when wanted by the farmer, and sprinkled by him on the land. There is very little smell from either pits or the farm lands, though garbage disposed of on lands in the same neighborhood is very offensive.

The liquid is said to be more effective as a fertilizer than the sludge, but more transient in effect. The soil is heavy, containing much clay, and the crops raised are principally cabbage, kale, tomatoes, potatoes and spinach. The night soil, it should be noted, is said to be applied to the crops some weeks before gathering.

I have described this system of nightsoil disposal somewhat fully, as it is carried on by a system and on a scale which are unique in this country.

In topography, the city is hilly, the northwest corner rising to 460 feet above tide. The area is about 32 sq. mi., comprising—

2½ sq. mi. of water surface,
8 " " " closely built up territory,
5 " " " partially " " "
and 16½ " " " rural area and parks.

Its surface has a decided slope toward the Patapsco river on the south, toward Jones Falls, a stream which flows in a southerly direction through the heart of the city, and to several other streams of more or less magnitude, ensuring a speedy and complete removal of sewage to the outfall.

In 1893 a commission was appointed by the Mayor to "examine into the necessity for a more perfect system of sewerage for the City of Balti-

THE NEW YORK
PUBLIC LIBRARY
ASTOR, LENOX AND
TILDEN FOUNDATIONS

* * * * "together with recommendations as to the system to
opted and the mode of carrying the same into effect."

his commission, which now consists of Messrs. Mendes Cohen,
Hambleton and E. L. Bartlett, presented its report last winter
a thorough investigation of the problems involved, in which they
aided by the services of Consulting Engineers Rudolph Hering,
el M. Gray and Gen. Wm. P. Craighill.

he entire design was seen to depend, first, on whether the combined
separate system should be adopted, and, secondly, on the method of
sal. Both of these decisions were controlled by the following con-
tions:

n the first place, the flow in the Patapsco, which can only result
the combined discharge of its small tributaries, is insignificant, and
ly inadequate to effectually dispose of the sewage from a large city.
consulting engineers estimated that it could be relied upon to dis-
of the sewage from but 37,000 persons without danger of offense.
n, the tides, which may be availed of during the ebb to carry down-
m sewage retained in reservoirs during the flood, are also quite
quate for the purpose, rising and falling on an average but about
ches. And finally, aside from any possible danger to riparian inter-
from fouling the shores, there were the oysters of the bay to pro-
—a very important source of revenue to the state and one giving rise
n industry employing a great many men. Therefore, the sewage, if
arged into the harbor, would have to be treated at an expense bear-
some relation to its volume; or, if carried by an outfall sewer to the
the great distance would preclude the conveyance of storm water as
without prohibitory expense.

For these and other reasons, together with the fact that storm water
ready partially provided for by a number of large and costly drains,
as at once decided that the separate system was the only one to be
sidered, and that the problem before the commission was virtually
ed down to that of disposal.

It was found that either of three plans was available: dilution in
sapeake bay, chemical precipitation, or agricultural filtration on the
dy soil of Anne Arundel County, some 8 or 10 miles south of the city.
Of these, the latter was agreed upon as the most perfect, because it
ld deliver, under proper superintendence, an effluent biologically and
mically pure. But, unfortunately, the cost of delivery by steel pipes
er the Patapsco in a siphon a mile long and through a tunnel 8,000
in length, in addition to a greatly increased annual charge for
npage, resulted in an estimated cost for construction of $17,451,803,
against $10,409,167 in the case of dilution; and for maintenance, of
6,843, as against $355,191. This difference of over 7 million dollars

for construction and $600,000 for maintenance made it incumbent on the commission to investigate the objections to dilution in Chesapeake bay.

A party was made up and stationed on a schooner in the bay, where current observations were made from a steam launch, and sometimes from a tug also, by means of sextant observations on known points from the positions occupied by floats. The floats were yellow pine rods, 2 inches square in sections and from 6 to 8½ feet in length, carrying a flag with a number for identification at one end and a weight consisting of iron washers strung on a wire at the other. They were set out from known positions from 1 to 3½ miles east of what is known as the Rear Range Light of the Craighill channel, at all stages of the tide, and observations were carried on for a full month. The plotted courses of these floats served to indicate the possible dispersion and drift of the sewage if discharged at the several points, and the conclusions reached were, that with the almost unlimited dilution from the watershed of the Susquehanna, exceeding that of any other river between the St. Lawrence and the Mississippi, there would be no question as to freedom from offense from the discharge of the sewage at a suitable point. Such a point was fixed as 2½ miles east of said light-house and some 2 miles from the nearest shore, the tendency of the currents being to carry any sewage discharged there down the channel in the center of the bay, as well as to ensure a rapid dispersion or mixing. Also, from the fact that the nearest marketable oysters lie in beds or on "lumps" in comparatively shallow water some 6 or 7 miles away from the proposed point of outfall, the danger of infection was believed to be so very remote as to be insignificant.

It was suggested that a discharge of sewage into the bay would be detrimental to fish life—the crabs, which form a staple food product of the state, as well as to the oysters and other mollusks. In this connection the following statements of Mr. Wm. M. Brown, Jr., Chief Engineer of the Metropolitan Sewerage Commission of Boston, regarding the discharge of 40 million gallons of sewage daily into the bay, are of interest. He says:

"Deer Island Bar, at the outer end of which our metropolitan sewer outfall is located, is visited by crabs and great quantities of star fish and minute mollusks and snails. Entire sections of this bar near the outfall are covered by these minute bivalves as with a carpet. They are not edible. The only edible fish products within the range of our outfall known to me are the well-known varieties of cod and perch, which are found in abundance within 500 feet of the outfall and used by our employees and others. Great quantities of lobsters are also obtained near by. Our employees for three years have maintained lobster traps within

t of the outfall, and within range of half a mile it is estimated that
re 200 others, the product of which is sold in the Boston market.
n & Co., * * * the most extensive dealers in lobsters in this
t, estimate that in Boston harbor, within a range of one mile from
tfall and that of the Boston Main Drainage Works at Moon
, 75 tons of lobsters are gathered annually for the Boston market."

l such assimilate sewage, if fresh, and convert it into perfectly good,
some food. The reason why a densely polluted water, such as is
in Baltimore harbor, will destroy fish life, is not that the sewage is
ul in itself, but that the bacteria developed therein deprive the
of its oxygen, upon which fish depend.

rom all the evidence collected, and a study of the subject from a
ical point of view as well, the commission felt justified in recom-
ing this less costly scheme, and so reported. The report, however,
a strong opposition from those interested in the oyster trade,
g an injury to their business if not to the oyster itself. So strong
his feeling that the commission was requested to continue its inves-
ons and recommend some system which would provide for purifica-
of the effluent. It was naturally assumed that agricultural filtration
d be the alternative selected, but, as is well known, the past year
been remarkable for the development of several processes of bac-
purification of sewage, including rapid filtration through specially
red media, which the commission has thought advisable to look
before arriving at definite conclusions. Among those of particular
inence just now are the septic tank treatment as in use at Exeter
Yeovil, England, and at Armagh, Ireland, and the Moncrieff process
installed at Caterham, England—both of which depend upon the
n of anaerobic bacteria; coke filtration, as employed by Dibdin at
on, England, and forced aeration as introduced by Col. Waring at
ow Grove Park, Pa., Homewood Park and Tuxedo Park, N. Y. The
national or ferozone-polarite process, too, is highly endorsed as a
hod of chemical precipitation, and a plant is just being installed for
City of Madison, Wis.

It remains to be seen whether one or more of these or other methods
urification may be availed of by Baltimore to advantage.

The problem of financing a piece of work such as this for Baltimore
f the utmost importance. The taxable basis of the city this year is
$367,042,811, and most of this is assessed close to its full valuation, at
te of $2.25 on the hundred. This, with the necessary expenses for
lic improvements, is already a burden to many, and the commission
therefore given considerable thought to the solution of the problem.

The reported estimates for the filtration scheme were as follows:

	Construction.	Maint., Int. and Renewals per annum.
For population of 330,000—		
Interceptors, pumping stations and disposal	$5,840,207	
District and lateral sewers	2,032,500	
Total	$7,872,707	$423,277

	Construction.	Maint., Int. and Renewals per annum.
For population of 1,000,000—		
Interceptors, pumping stations and disposal	$12,196,803	
District and lateral sewers	5,280,000	
Total	$17,476,803	$966,844

In general, the plan recommended contemplates an issue of long-term bonds to provide for the construction of the interceptors, outfall mains, pumping plants and the disposal works, while the network of laterals would be paid for by direct assessment against abutting property. The annual charges, consisting of interest, sinking fund, maintenance and renewals, would be met by a system of rentals similar to that in use by the Water Department. Such a plan has just been adopted by the City of Boston for its sewerage work.

Based upon the estimates given in the report for the most costly project—that of agricultural filtration—this annual rental per house would probably average at first somewhere between $5.00 and $10.00, and this would diminish as time went on, until, after the liquidation of the bonded debt and deducting the actual present cost of cleaning cesspools, the extra expense due to the installation and operation of the proposed works would practically disappear.

THE PRESIDENT: I think all who represent cities situated upon rivers or inland streams have had this experience, that as a rule each city government is satisfied if it can get clear of its sewage just below its own doors, and the fact that it may have an injurious effect upon those who live further down the stream does not concern it very much. I know that is the case with the Passaic river and the cities along its banks. These different cities and towns empty their sewage into the Passaic river, and it has become so foul as to be a serious source of danger to all of them. I think that all who have these conditions to face will be interested in the next paper, the subject of which is a proposed sewage disposal system for Washington, D. C. We shall be glad to hear if they can take care of their sewage without interfering with anybody below them on the Potomac river. Mr. D. E. McComb, Superintendent of Sewers of Washington, D. C., will present the paper.

THE SEWAGE DISPOSAL PROJECT FOR WASHINGTON. D. C.

(By D. E. McComb, Superintendent of Sewers, Washington, D. C.)

The City of Washington is situated at the junction of the Potomac and Anacostia rivers, Rock creek forming a portion of its western boundary.

The main drainage areas were originally Tiber creek, 5,550 acres, 2,950 acres of which were outside of the city limits; St. James creek, 600 acres, and Slash run, 810 acres, 160 acres of which were outside of the city limits. In addition, 200 acres drained directly to Rock creek, 1,300 acres drained directly to the Anacostia river, and 700 acres drained directly to the Potomac river. The surface elevation of the lower portion of the Tiber Creek valley and of the valley of St. James creek were but few feet above mean high tide level in the Potomac river, and the street grades over a portion of these areas, containing about 400 acres, including Pennsylvania avenue between Second and Thirteenth streets west, are between seven and twelve feet above mean high tide level. This area is subject to flooding during extreme stages of high water in the Potomac river, resulting in damage to property, on account of which the city is at present the defendant in a large number of suits at law.

In the year 1832 the construction of the Washington canal—between the Potomac and Anacostia rivers by way of the lower portion of the Tiber Creek valley, from the Potomac river near the foot of Seventeenth street to Third street west, thence by way of Third street and Canal street to the Anacostia river—furnished a trunk line of drainage for the greater portion of the improved section of the city. A few drains and sewers were constructed prior to the introduction of the Potomac water supply in the year 1858, and after that year the construction of sewers, most of which discharged into the Washington canal, became a prominent feature of municipal expenditure. It was not very long before complaints were made of the filthy condition of the canal, and many suggestions were offered for its improvement. One proposition was to create a current by the use of a propeller wheel; this was long before the Benzenberg-

Reynolds screw pump was so successfully installed in Milwaukee for the same purpose. When the form of government was changed in 1871, and the Board of Public Works began its task upon the comprehensive plan of improvements, one of the first problems for solution was the improvement of conditions in this main drainage line. It was decided to construct two trunk sewers to take its place, one of which was located in B street, between Seventh and Seventeenth streets, and is known as the B street sewer; the other sewer was located in Missouri avenue, Third street and Canal street, discharging into the James Creek canal, thence into the Anacostia river. The portion of this sewer which is located in Third and Canal streets also extends northward from Missouri avenue, and is known as the Tiber sewer. When the Potomac flats were filled, a canal was constructed from the outlet end of the B street sewer to the bulkhead line, which is known as the Seventeenth street canal. After the B street and Tiber sewers were completed, the Washington canal was filled and the lateral sewers were connected with the trunk sewers above described. In a short time it was discovered by the Board of Public Works that the Tiber sewer was inadequate, and a sewer was constructed along Florida avenue from Second street east to Cool Spring run, near the intersection of Seventeenth and E streets, which was intended to intercept all drainage from the territory northward from Florida avenue, between Second and Fifteenth streets east. This sewer did not meet the expectation of its designers, and the Northeast Boundary sewer was constructed, 1879-1885, for the purpose of intercepting all drainage from the territory northward from Florida avenue which formerly reached the Tiber sewer. Although relieved of a large amount of drainage, the Tiber sewer is still inadequate, and storms of exceptional severity contribute an amount of drainage beyond its capacity. A trunk sewer was constructed by the Board of Public Works in the valley of Slash run. It was found necessary to relieve that sewer by intercepting sewers in Q street and in Florida avenue. By these sewers the sewage of Washington was discharged into the Seventeenth street canal, the James Creek canal, Cool Spring run, Rock creek, and a small amount directly into the Anacostia and Potomac rivers. The discharge of sewage into these canals and into Rock creek caused, in a short time, a state of nuisance to exist in each of these bodies of water, and the attention of Congress was invited to the necessity for providing more adequate means of sewage disposal. In 1890 a report was submitted by a Board of Sanitary Engineers, provided for by Congress and appointed by the President of the United States, consisting of Rudolph Hering, Samuel M. Gray and Frederic P. Stearns, in which was recommended the construction of intercepting sewers to convey practically all of the sewage to a pumping station at the southerly end of New Jersey avenue, there to be raised and discharged into an inverted siphon laid under the bed of the Anacostia river, from the pumping station to Poplar point, from which a trunk sewer is proposed to Magazine point, where the sewage will be discharged into the Potomac river. This point was selected in order that the sewage discharged should not be carried back to the portion of the river adjacent to the city by the tides.

The subject of sewage disposal could not be separated from that of protecting the low-grade section of the city from flooding during high stages of the Potomac river. With this in view it is proposed to construct a dike along the line of Virginia avenue, crossing the Tiber valley, and another dike along the line of N street south, crossing the St. James creek valley; intercepting sewers are provided to divert, as far as possible, the drainage from the higher areas which reach this section, and the main drain will be of sufficient capacity to convey, in addition to the sewage, the storm water of the low-grade section. At the pumping station auxiliary pumps will be provided to discharge into the Anacostia river this storm water. At ordinary stages of the river the drainage from the low-grade area will be discharged by gravity into the Anacostia river, except the drainage from the parked area, which will be discharged into the Potomac river by means of the B street sewer. The amount of sewage to be provided for was assumed at 20 cubic feet per head per day, including ground water reaching the sewers; and to provide for variations in rate of flow, and for a small amount of rain water, the Board of Sanitary Engineers decided that trunk sewers should be constructed to carry 20 cubic feet of sewage per head per day when running half full.

The work accomplished to date upon this project consists in the following: Easby Point and F street intercepting sewer, 10,332 feet long, varying from 11′ 3″ to 4′ 6″ diameter; this sewer intercepts and discharges into the Potomac river, near Easby point, sewerage and drainage which formerly discharged into the B street sewer and Seventeenth street canal, from the area north of F street between Seventh and Fifteenth streets, and from the area north of D street between Seventeenth and Twenty-third streets—1,135 feet of this sewer was constructed upon pile foundation, and a short section, crossing an old creek-bed with spongy bottom, was constructed upon a foundation of concrete masonry, in which was imbedded two layers of old iron rails.

The sections in Fifteenth and F streets were constructed without material interference with traffic upon these busy streets, the materials being handled by means of a conveyor. To prevent complaints on account of mud and dust, and at the same time to permit a reasonable length of time to elapse for the consolidation of the trench backfilling, a temporary plank flooring was laid over the sewer trench after it was backfilled, and it was maintained for several months, after which the asphalt carriageway was restored. The section of the Rock creek and B street intercepting sewer between G and P streets, 5,650 feet long, 6 feet diameter, intercepts and discharges into the Potomac river, near the foot of G street, all sewage formerly discharged into Rock creek by the main sewers of Georgetown, as well as that discharged into the same stream by the Washington sewers. This sewer was not constructed upon the lines selected by the Board of Sanitary Engineers, which involved a large amount of tunnel work; instead, it was constructed along the east shore of Rock creek, and its length was thereby materially shortened. The only portion constructed in tunnel was under M street, a short distance east of the east abutment of the M street bridge. This portion of M street had been filled with ashes and other like materials, and the filling so lacked coherence that it was considered prudent to support the 48" water main, which crossed the sewer line, by a pair of steel girders placed upon abutments resting upon solid rock.

The sewage from the Georgetown sewers is intercepted by a sewer in Twenty-seventh street and discharges into an iron sewer in M street, by which it is conveyed across Rock creek and is discharged into the Rock creek intercepting sewer. The iron sewer crossing Rock creek is supported by a truss placed between the abutments of the M street bridge.

The crossings of Slash run and Northeast boundary sewers involved reconstruction of sections of each, the intercepting sewer being carried above these sewers, which discharge storm water into Rock creek. The sewage is diverted at points above the crossings and is conveyed by low-grade sewers to the intercepting sewer. In addition to the above, 2,500 feet of the Rock creek and B street intercepting sewer have been constructed from the intersection of Twenty-seventh and G streets towards its outlet, leaving for completion 3,400 feet of this line, upon which work is now in progress. This sewer is intended to convey, upon completion of the project, all sewage from the Rock creek and Slash run systems, and from the area drained by the Easby point and F street intercepting sewer, to the B street and New Jersey avenue trunk sewer; 2,300 feet of the Tiber creek and New Jersey avenue high level intercepting sewer, between the south line of Garfield park and the intersection of Canal and D streets, have been constructed, leaving for completion 6,284 feet of this line, upon which work is now in progress. This sewer is of D section, 14′ by 14′ 3″, and has a central cunette for dry weather flow. Its object is to intercept the old Tiber sewer near the intersection of First and C streets N. W., and in addition all sewers discharging from the eastward into the Tiber sewer between that point and Virginia avenue. Incidental to the preparation of plans for the pumping station, borings over the proposed site and gaugings of sewage flow are in progress. Upon the remaining portions of the project no work has been performed. The following is a brief description of each:

The Four-and-one-half street intercepting sewer will intercept drainage from the area of South Washington, which now drains into the low district, as far north as B street and as far east as Four-and-one-half street; its outlet for storm water will be the Washington channel of the Potomac at M street.

The east side intercepting sewer (including the extension of Boundary sewer) will convey the sewage of the eastern section of the city (not including that portion tributary to the Tiber creek system), and it will discharge into the B street and New Jersey avenue trunk sewer at M street.

The Water and M street intercepting sewer will intercept the sewage of South Washington, now discharged into the Washington channel of the Potomac, and the sewage of the James creek valley south of H street; it will intercept also, in its lower portion, all of the storm water from the low area between H and N streets; it will empty into the B street and New Jersey avenue trunk sewer at M street.

The B street and New Jersey avenue trunk sewer will receive all the storm water of the low district which may not be disposed of otherwise than by pumping; it will receive, at its upper end, the sewage conveyed by the Rock creek and B street intercepting sewer, and near its lower end, the sewage conveyed by the East Side, the M street and the Tiber creek and New Jersey avenue high level intercepting sewer; in addition, it will receive the sewage of the territory in which it is located, and will, therefore, deliver to the pumping station all the sewage of the city and the storm water of the low district.

The pumping station is to be located at the southerly end of New Jersey avenue, and it will be provided with sand and screen hoists, high duty pumps for lifting sewage, and low duty pumps for lifting storm water.

At the pumping station the sewage will be discharged into the siphon chamber, from which it is proposed to construct an inverted siphon, consisting of three lines of cast iron pipes, across the Anacostia river to Poplar point.

The outfall sewer will skirt the river shore, between Poplar point and Magazine point; it will be of horseshoe section, 9′ 4″ wide, 8′ 4″ high, and 3 miles long.

Automatic regulators will be provided at points of sewage interception, and tidal gates will be placed at the outlet ends of the old sewers and of the intercepting trunk sewers.

This work was commenced in the year 1893, the amount expended to date and available is $772,000, and the amount required to complete the project is $3,257,635. At the rate of progress heretofore made, the completion of the work may be expected about the year 1925.

The general rules followed in the work of sewer construction in Washington may be of interest.

The earlier sewers were built with stone side walls upon plank flooring and covered with planking; other types were of D section, with plank, stone or brick bottoms, with stone side walls and brick arches; and others were brick sewers of circular section, commonly called "barrel sewers." Pipe sewers were introduced about the year 1870, and within the next succeeding four years more than 60 miles of sewers of this type were laid. After the change in the form of government of the District, in 1874, the Engineer of the Board of Commissioners, Lieut. (now Major) R. L. Hoxie, was made aware of and corrected many defects of design and construction in the sewers more recently constructed, in progress and in contemplation. The sizes were generally too small to take care of heavy rainfalls; the bottoms of main sewers were of common brick masonry and were badly worn in cases where gradients were at all considerable; the forms given to the inverts were such that the sewage flow was not concentrated; the bedding, alignment and jointing of pipe sewers were defective, and much inconvenience was caused by the intrusion of tree roots, which developed within the pipe sewers sufficiently to obstruct the sewage flow.

The sizes of proposed sewers were increased; intercepting sewers were constructed; the inverts of main sewers were designed of materials selected to resist abrasion, and were shaped to concentrate the sewage flow; pipe sewers were designed with concrete cradles and concrete enveloping joints, and care was taken to secure good alignment. These general rules are at the foundation of the practice of to-day.

The sewers of Washington (including the whole of the District of Columbia) are designed to carry storm water and sewage, with the exception of a few small suburban areas, where they are designed to convey sewage only. An empirical formula, which seems to fit local conditions, is used to determine the amount of drainage to be provided for.

The formula gives large unit rates for small areas, the rate decreasing as the area increases. The sizes are determined by the use of the Kutter formula, in which .013 is used as the coefficient of friction.

Sewers between 8 and 24 inches in diameter are made of stoneware pipes laid upon a cradle of concrete masonry, the joints being covered with a concrete enveloping band. Above 24 inches diameter, they are made egg-shape until the 4 feet by 6 feet size is reached, which is the largest regular section; sewers above that size are considered exceptional and are designed with reference to the location and conditions.

In main sewer work that portion of the sewer which is below the springing line is constructed of concrete masonry, lined with a wearing surface of vitrified brick masonry from the bottom to a line midway between the bottom and the springing line. Above the vitrified brick masonry the lining is of ordinary brickwork, the same thickness as the vitrified brick masonry. In sewers 4′ by 6′ and smaller, stoneware invert blocks are laid in addition to the lining of vitrified and ordinary brick masonry described above. In a few cases of sewers having light gradients, constructed in dry ground and designed to convey sewage only, unlined concrete sewer inverts have been constructed with satisfactory results. The arches of main sewers are constructed either of ordinary brick or of concrete masonry, the selection being controlled by local conditions.

Concrete masonry used in pipe sewer work and elsewhere, in walls less than 6 inches thick, is composed of beach pebbles, each particle of which must pass through a 1½″ ring, mixed with an amount of mortar (composed of cement, 1 part; sand, 2 parts), which shall be 30% in excess of the volume of voids in the gravel.

Concrete masonry in more massive construction is composed of broken stone, each fragment of which must pass through a 2″ ring, gravel and mortar. The amount of gravel used equals the volume of voids in the broken stone, and the amount of mortar is 30% in excess of the volume of voids of the mixed stone and gravel.

A local inspector is provided for each section of work under contract; the general inspector makes daily visits to each piece of work in progress, and the assistant engineer in charge exercises supervision over all work under his direction.

Constructions exceeding $1,000 in cost are performed by contract; the work performed by day labor is limited to the smaller lines of pipe sewers and sewer appurtenances.

THE PRESIDENT: Gentlemen, it is evident that Washington has its own troubles to contend with in respect of its sewerage, and judging from Mr. McComb's paper, in about 25 years from now, the sewage of Washington will be deposited somewhere a few miles below the city. I do not know whether there are any towns to be affected by the discharge of sewage below or not, and we perhaps will hear more about that in the discussion which is to follow. There is one other paper on the sewage question. The subject of this is, Some Observations on the Effect of Flushing Devices in Small Sewers, by Asa E. Phillips, Assistant Engineer of the Sewer Department of Washington, D. C. After that paper we shall have some discussion and questions and answers on the papers that have been read.

SOME OBSERVATIONS ON THE EFFECT OF FLUSHING DEVICES FOR SMALL SEWERS.

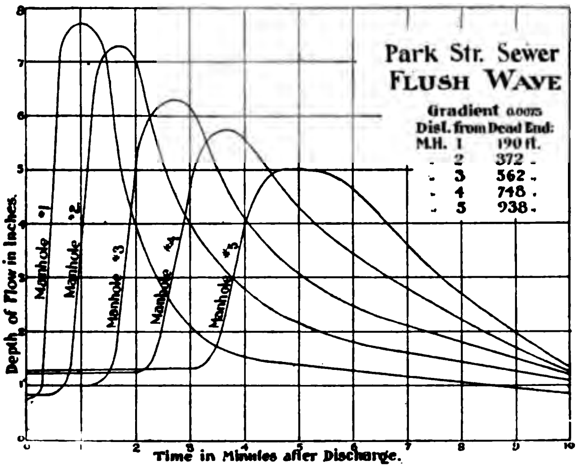
(By Asa E. Phillips, Assistant Engineer Sewer Department,
Washington, D. C.)

The general principle of the flushing device is to suddenly discharge into the sewer a considerable volume of water for the purpose of cleansing the pipe of stranded solids. As a rule, the siphon is 6 or 8 inches in diameter, and is usually somewhat smaller than the sewer to which it is connected. The quantity of water is measured by the horizontal section of the tank, since the depth of discharge is ordinarily constant for one size of siphon. The amount of discharge per second varies somewhat for the different varieties of the device and different local conditions. but is roughly stated as one cubic foot per second for the 6-inch siphon, and two cubic feet per second for the 8-inch. No formula has been proposed for the volume of water required for different grades and sizes, and the only rule known to have been used appears to be of little value. This important detail is determined by individual judgment, generally unsupported by investigation or experience, so that the common practice has varied within a large range of values, while tanks of uniform size usually have been constructed regardless of differences in the size or gradient of the sewers to be flushed The uncertainty as to the precise effect of the flush, and the complex conditions as to contributing population, rate of water consumption, etc., have been justly considered a bar to any precision in this respect. Recent discussion of the subject, however, has tended to establish certain limitations in the use of flushing devices, which should lead to improvement in the general practice.

The work to be accomplished by the flush is the removal, at regular and frequent intervals, of solid matter flushed into the sewer from house laterals, and there stranded because of the shallow depth of flow and sluggish current, and its carriage down the line to a point where the depth and velocity are sufficient to insure removal, to the ultimate point of discharge. The efficiency of the flushing device in performing this work is not well understood. But little is known of the effect under the varying conditions encountered, especially for widely different grades, and at considerable distance from the dead end. It is generally considered, however, that the effect diminishes very rapidly as the distance increases, and becomes almost imperceptible 600 or 700 feet from the tank; but, so far as can be ascertained, this has been observed only in cases of flush of small volume on flat grades, or where the depth of ordinary flow was considerable. Of the effect of discharge of 600 gallons or more, such as were used in the cases to follow, there appears to be no recorded observations, so that no comparison with those already published can be made. Several grade conditions have been selected, for the purpose of illustrating the effect of the flush under such circumstances, and an attempt made to indicate, by means of diagrams, the different results obtained. For these no special accuracy is claimed, but in the few cases given the differences are sufficiently marked as to suggest certain conclusions therefrom.

The Park street line is the first of these. This sewer is 12 inches in diameter, about 1,870 feet in length, and has a uniform grade throughout of 9 inches per 100 feet. Preliminary examination discovered slightly unfavorable conditions for experimental work, such as an uneven grade, rough joints and poor alignment in places, all of which affected the observations and results to some extent. It may now be stated that, with the exception of the Chapin street line, the sewers cited are old and generally possess these irregularities, but excepting slight silt accumulation at points distant from the basin, they were found to be very clean. The presence of even a small amount of silt in the invert, particularly at manholes, undoubtedly affected the flow and was the chief source of error in the observations.

The tank on Park street was found to have an effective capacity of 84 cubic feet, or about 630 gallons, and discharged through an 8-inch siphon in the mean time of 42 seconds. No attempt was made to determine the velocity at the point of discharge, but this date would indicate an approximate mean velocity of 6 feet per second. Observations of the flush were simultaneously taken at all of the manholes, and the depths of flow were recorded at intervals of 15 seconds or less. These depths were referred to the time of siphon discharge, and the diagrams of the flush have been constructed from this datum.



The first diagram, Figure 1, shows the form of the flush wave as taken at five consecutive manholes, within 1,000 feet of the tank. The lower four manholes were not plotted, because of the confusion of lines that would result, but the data are given in Table 1. This diagram and tabulation shows how well the depth of flow is maintained for very long distances. One thousand feet from the dead end the flush is very efficient, and at a distance of nearly 2,000 feet appears to be quite effective. This large radius of effect is doubtless due to the volume of water used, as published data for smaller discharges indicate that a tank of half this capacity would have a very greatly diminished influence.

Table 1. Park Street Sewer.

Capacity of Tank, 84 cubic feet, 630 gallons Time of Discharge, 42 seconds.

Manhole	Size	Gradient per cent.	Distance from Dead End Feet	Depth of Flow Inches		Duration of Greatest Effect	
				Normal	Flush	Min	Sec
1	12″ d.	0.75	200	¾	7¾	1	00
2	"	"	382	⅞	7¼	1	15
3	"	"	572	1	6¼	1	45
4	"	"	738	1¼	5¾	2	00
5	"	"	948	1¼	5	2	15
6	"	"	1132	....	....	..	..
7	"	"	1332	1⅜	4½	2	45
8	"	"	1486	1½	4	3	00
9	"	"	1688	1¾	3½	3	45
10	"	"	1869	1¾	3¼	3	45

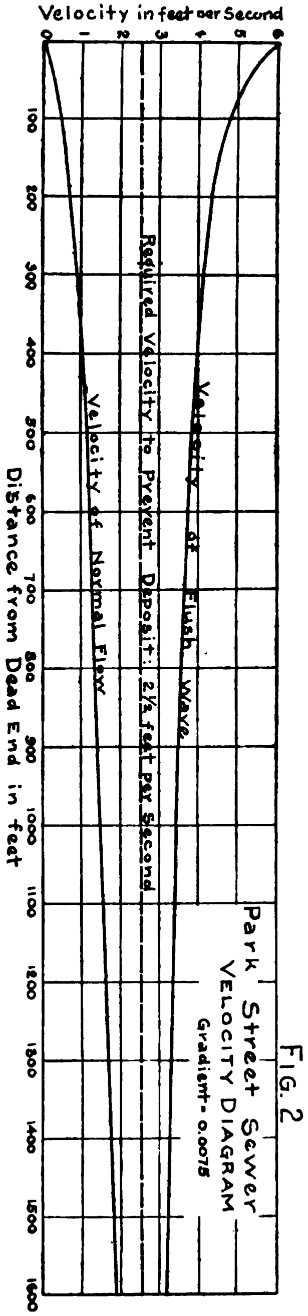


FIG. 2

Park Street Sewer

VELOCITY DIAGRAM

Gradient-0.0075

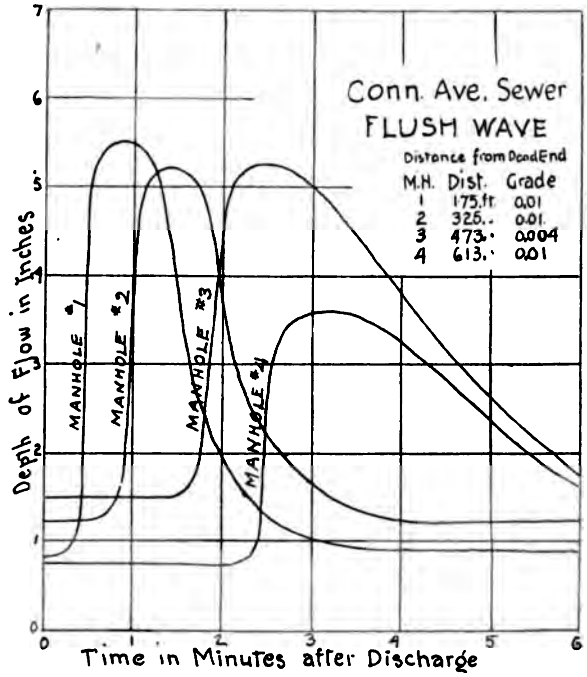
The second diagram for this line (Figure 2) shows the computed velocity curve for the ordinary flow, the assumed velocity to prevent sedimentation, and the accelerated velocity due to the flush. These curves are not supposed to be precise, but they illustrate the purpose of the flushing device, and to some extent the degrees of effectiveness required. The curve of normal flow shows the very low velocity along the upper portion of the line, and its gradual increase approaching the required velocity at the lower end, while the flush curve shows a corresponding high velocity at the upper end and its rate of fall toward the 2½ foot per second velocity, where in theory, at least, it would seem that the two curves meet at a common tangent point. In this sewer, it may be noted, the normal flow does not attain a rate of 2½ feet per second, and probably would not for a distance of 2,000 feet. It is also to be observed, however, that the flush would seem to maintain this velocity for a distance probably as great; so that, so far as these observations go, they indicate that for this very long line and flat grade the flush tank is efficient and of the proper size.

The second series, taken on one of the Connecticut avenue sewers, is chiefly interesting as showing the effect produced on a varying and decreasing gradient.

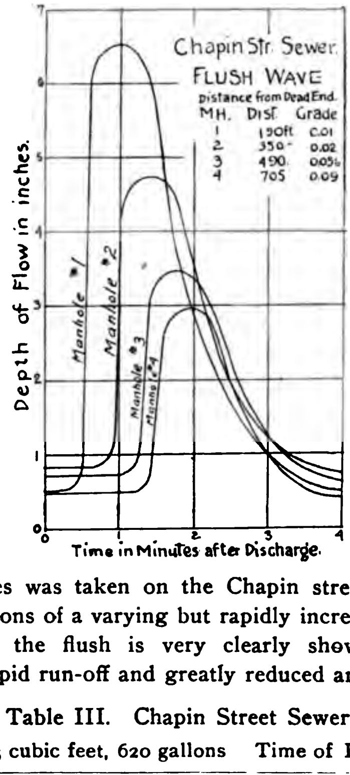
Table II. Connecticut Avenue Sewer.

Capacity of Tank, 82 cubic feet, 615 gallons. Time of Discharge, 45 seconds.

Manhole	Size	Gradient per cent.	Distance from Dead End Feet	Depth of Flow Inches		Duration of Greatest Effect	
				Normal	Flush	Min	Sec
1	12″ d.	1	175	⅞	5½	1	15
2	“	1	325	1¼	5¼	1	30
3	“	0.4	473	1½	5¼	3	00
4	“	1	613	1	3½	3	00



The diagram (Figure 3) illustrates the diminished velocity and enlarged area of section of the flush wave as recorded at manhole No. 3, showing the marked effect of the diminished rate of grade in the portion of the sewer immediately above. Unfortunately, this could not be further observed, owing to a change in gradient from this point. It probably indicates, however, that for a line of varying slope the minimum should be considered in fixing the capacity of the tank.

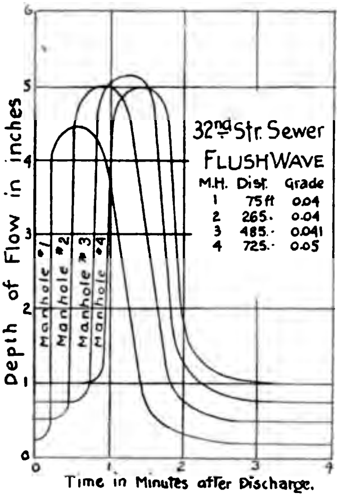


The third series was taken on the Chapin street sewer, which has the reversed conditions of a varying but rapidly increasing gradient. The observed effect of the flush is very clearly shown by the diagram (Figure 4). The rapid run-off and greatly reduced area of section toward the lower end of the sewer indicate the very high velocity which such steep slopes must produce. In this case, the minimum grade being 1%, and that for a length of only 190 feet, a flush tank of considerably less capacity would probably be sufficiently effective, if indeed for such grade conditions automatic flushing is at all necessary.

Table III. Chapin Street Sewer.

Capacity of Tank, 83 cubic feet, 620 gallons Time of Discharge, 48 seconds.

Manhole	Size	Gradient per cent.	Distance from Dead End Feet	Depth of Flow Inches		Duration of Greatest Effect	
				Normal	Flush	Min	Sec
1	12″ d.	1	190	½	6½	1	00
2	"	2	350	¾	4¾	1	00
3	"	5.6	490	¾	3½	1	00
4	"	9	705	½	3	1	00

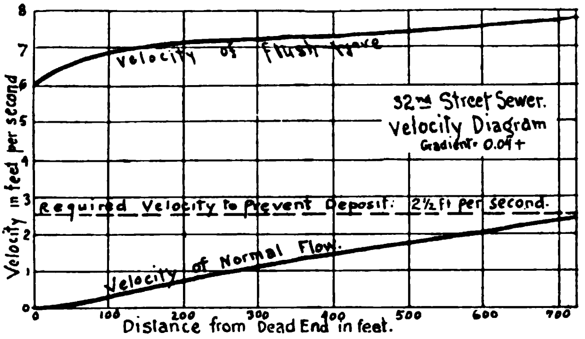


The fourth series, taken on one of the Thirty-second street sewers, shows the observed effects on a nearly uniform steep grade. The first diagram (Figure 5) for this line shows the form of the flush wave as observed at each manhole. The quick run-off and nearly uniform area of section maintained indicate the piston-like effect of the discharge. In fact, the flow was so rapid and so quickly past as to render the taking of the observations rather difficult and their relative accuracy to some degree uncertain. The curves here and there seem to suggest such unavoidable

Table IV. Thirty-second Street Sewer.

Capacity of Tank, 84 cubic feet, 630 gallons. Time of Discharge, 48 seconds.

Manhole	Size	Gradient per cent.	Distance from Dead End Feet	Depth of Flow Inches		Duration of Greatest Effect	
				Normal	Flush	Min	Sec
1	12″ d.	4	75.	⅛	4½	1	00
2	"	4	265.	¼	5	1	00
3	"	4.1	485.	¾	5⅛	1	00
4	"	5	725.	1	5	1	00



irregularities, but the general effect is very clearly shown. The second diagram (Figure 6) indicates the approximate velocity attained by the flush in connection with the assumed 2½ feet per second constant, as well as the estimated velocity of ordinary flow. This shows, in another form, the marked effect of the discharge on a steep slope, and also how quickly on such grades the normal flow attains sufficient velocity to prevent deposit. From a study of these diagrams we may conclude that the flush increases rapidly in effectiveness as the grade increases, having a remarkable scouring power on grades of 4% or more, but at the same time the necessity for automatic flushing decreases correspondingly, there being apparently little need for such a device on slopes approaching 4%.

As has been stated, no formula has yet been proposed for the quantity of water required to flush for the several conditions as to size, gradient, etc. In a general way it has been said that "long lines on flat grades require greater capacity of tanks than steep slopes or short lines"; but no attempt to formulate these factors for discussion has been made. Aside from the cost of construction and maintenance, economy in the use of water would give to the subject some importance, for one 400-gallon tank requires for a 36-hour discharge no less than 100,000 gallons per annum. However, the uncertain and variable conditions controlling the amount of ordinary flow, etc., would make such a formula of little practical usefulness; it would seem of some value in considering the factors in the problem which are comparatively well understood, at least so as to show to some degree the limitations governing the use of this device for the conditions which are easily determined. Briefly, the object of the flush is to secure a periodic velocity of more than 2½ feet per second in the upper portion of the sewer, and to maintain the same to a point where the ordinary flow attains this rate. Disregarding the amount of normal flow, it is evident that the quantity of water to satisfy this condition is a function of the diameter of the sewer and of its gradient. From general consideration of the well-known formula for velocity,

$$V=C\sqrt{RS}$$

remembering that for circular conduits the hydraulic radius is a direct function of the semi-diameter, we may consider (1) the quantity, Q varies directly as the square root of the radius, and inversely, as the square root of the slope; and, to complete the statement of controlling conditions, (2) that it varies directly as the length of sewer from the dead end to the point where the normal flow becomes sufficient to maintain a velocity of 2½ feet per second. Under these assumed conditions, designating this distance by L, in linear feet, letting C represent the necessary modifying coefficient, Q the quantity in cubic feet and R the radius of the sewer in feet, the formula would take the shape

$$Q=\frac{L\sqrt{R}}{C\sqrt{S}}$$

Solving this equation from the data given on the Park street line, we obtain a rough approximation for C of 190.

Let us now consider the factors which establish the value of L. If we let A represent the area of cross-section of normal flow for any given gradient required to produce the velocity of 2½ feet per second, and let D equal the increment in discharge for each linear foot of sewer in cubic feet per second, then

$$L=\frac{2\frac{1}{2}A}{D}$$

In which A is definitely determined by an application of Kutter's formula. The quantity D is evidently a function of the number of persons or premises tributary to the sewer, and of their per diem in water consumption. But these are variable quantities, rarely the same for two sewers. A uniform contributing population of 30 persons per 100 feet of sewer, with a daily flow per capita of 100 gallons, ¾ assumed to run off in 6 hours, would give a value for D of 0.00015 cubic feet per second. Table 5 gives the value of A for different grades and the corresponding depth of flow in inches.

Table V.

Grade per cent.	Areas of Section for 2½ feet per second velocity—square feet.				Depths of flow in inches for 2½ feet per second velocity.			
	6″ d.	8″ d.	10″ d.	12″ d.	6″ d.	8″ d.	10″ d.	12″ d.
½	....	0.229	0.226	0.235	.....	5.0	4.3	4.1
¾	0.135	0.132	0.140	0.149	3.9	3.3	3.0	2.9
1	0.096	0.098	0.108	0.116	2.9	2.6	2.5	2.4
2	0.046	0.050	0.055	0.060	1.7	1.6	1.6	1.5
3	0.031	0.034	0.038	0.041	1.3	1.2	1.2	1.2
4	0.023	0.026	0.029	0.031	1.0	1.0	1.0	1.0
5	0.019	0.022	0.024	0.026	0.9	0.9	0.9	0.9

This table indicates the very small flow on the larger grades necessary to maintain a self-cleansing velocity, and the relation between the ordinary discharge and the rate of grade within the limits given.

Table 6 gives the various quantities of water obtained by the formula for the foregoing grades and sizes, under the conditions which have been stated, allowing an increased rate on long lines and a diminishing rate of flow on short lines, from the average value of 0.00015 cubic feet per second.

Table VI.

Grade per cent.	Volume of water to flush by formula—Cubic feet.		
	8″ d.	10″ d.	12″ d.
½	80	90	100
¾	55	65	80
1	45	55	70
2	20	30	35
3	15	20	25
4	10	15	20
5	8	10	15

These results indicate that a very considerable modification of the volume of water should be allowed for lines of different gradient, and that the required volume diminishes very rapidly with an increase of grade; also that it is affected to a smaller extent by the size of the sewer; that for all sizes no flush tanks are probably required on slopes exceeding 2 per cent. and it may be inferred in such cases also that flushing at less frequent intervals is needed than the 24 to 48 hour discharge.

The rule previously alluded to, is given by the manufacturer of the VanVranken siphon and is as follows: "The capacity of the basin should be equal to that of one-half the length of sewer in which the grade produces a rise equal to the diameter of the pipe." For the purpose of comparison with the formula already given, we may readily reduce this statement to the form

$$Q = \frac{3.14 R^3}{S}$$

in which Q quantity of water in cubic feet
R radius of the pipe in feet and
S grade.

In this formula it appears Q varies as the third power of the radius. That this does not seem to satisfy the hydraulic conditions imposed may be readily seen for example in the case of a 10″d. and a 12″d. pipe, the quantities for which should not greatly differ. Only about one-half the volume is given for one as for the other. Also varies directly as the slope, giving but one half the quantity for an 0.8 as far a 0.4 per cent. grade. The effect of changes in size and grade are thus considerably exaggerated as inspection of the formula at once indicates.

To smaller degree the proper proportioning of the flush tank would seem of the same importance as that of the sewer itself. But in communities having a limited supply of water the question becomes more serious and in one case (*) at least, has seemed to justify abandoning the use of automatic flushing altogether. Although hand flushing is reported to have kept this system in working order the actual condition of the sewers would have to be more carefully studied before concluding the method an unqualified success. In any case, the flush tank is an excellent device, and under the best conditions performs its work admirably. It is true its automatic action is considered by many to be very unreliable; but this is largely due to a lack of understanding of the simply physical laws governing its operation, as well as to a deep rooted impression that it is a sort of perpetual motion machine—once started to run forever.

---

*Mount Vernon, N. Y., Semi-annual Flushing. Water mains connected direct with sewers at dead end. See Transactions Am. Soc. C. E., Vol. XXXIV, No. 3.

With reasonable care in construction, supplemented with intelligent and methodic inspection, the siphon will give a service of almost absolute regularity, and without wasteful use of water.

The employment of an insufficient volume of water to effectively flush, is an error of no less consequence, and probably has brought the flush tank into some disfavor, for a small discharge has been found to exhaust its effect within a short distance of the dead end without accomplishing the work intended, while at the same time the annual expenditure of water has been large, and more than sufficient for a thorough, if less frequent, flushing by other means. No arbitrary minimum for the capacity of the basin can be stated, but it seems probable that for lines requiring less than 300 gallons, automatic flushing had best be omitted. And finally it would appear that the flushing device can hardly be expected to impart a cleansing velocity on grades too small to maintain the same.

As has been seen, no attempt is here made to indicate the results with a variable volume of discharge, for the purpose of determining the comparative radius of effect under such circumstances. This and other interesting details are necessarily omitted; an effort having been made only to show the general influence of the slope on the flush, and in a limited way, the range of effect.

In conclusion it may be said that the formula suggested is not expected to satisfy exactly all of the fixed hydraulic conditions of the problem. That it approaches the form which such an equation should have and indicates the limits governing the use of flushing devices is that that can be said.

ASA E. PHILLIPS,
Assistant Engineer, Sewer Department,
Washington, D. C.

The President: I should like, before we proceed with the discussion of these papers, to call attention to the importance of this evening's meeting. We are to name the committees which are to suggest the officers for the ensuing year, and also to suggest the place of next meeting. So I hope all members will be present at the evening session. Now is the time for discussion, or any miscellaneous papers on the general subject of sewerage and sanitation, or for asking any questions of those who have read the papers to which we have listened this afternoon.

Captain Beach: Mr. President, you made some remarks, a little while ago, about the effect of sewage upon those living further down upon a river, and that it is now considered hardly fair play, for one city located upon the a river to dump its sewage into that river when there is another town below. As Washington might be subjected to that imputation, from the papers that were read, I would invite attention to the condition of the Potomac River. It differs from most streams in the country in the fact that there are no towns or even villages upon its lower portion. There are only one or two little hamlets between Alexandria and Chesapeake Bay. The volume of tidal flow a short distance below the city becomes considerable, so that it has been considered that the sewage of the city could be turned into the Potomac undiluted, at least for a great many years to come, without causing any nuisance to anybody living upon its banks.

Mr. Sherrerd: Mr. President, in the paper in regard to the sewage of Vienna, I was not able of course to transfer all of the quantities given in metric figures to our standard, but I want to call attention to the fact that the amount of water consumed, which I think was given as seventy-three thousand cubic meters per day, would be equivalent to about nineteen million gallons, and I understand that the population of Vienna is about 1,300,000, which would be equivalent to about 15 gallons per capita per day. In making any comparison of the cost of this method, as suggested by the commission, and applying it to cities in this country, the quantity of water that would flow into the sewers here would be vastly greater, and the dilution no doubt would be so much higher than was the case in Vienna that the by-products could not be as cheaply obtained. This should be considered in any comparison.

Mr. Benzenberg: I think that becomes quite apparent in the paper read by Mr. McComb, wherein he states that the commission which designed the intercepting sewer system for the purpose of pumping out the dry weather flow made an allowance of 20 cubic feet per day per capita, which would be about 150 gallons as against a little over 15 gallons allowed in Vienna. I do not understand that Mr. McComb stated the amount of storm water the commission allowed in the low level district to be taken up by the intercepting sewers, and if I failed to hear it I should like to have Mr. McComb repeat it, and while he is answering that I should like to ask him, when the commission adopted the factor of .013 in the Kutter formula, about what did they have in mind for the interior face of the sewer; whether it was contemplated that the sewer in the lower part of the invert should be constructed of vitrified brick or not, when that factor was determined, or whether the factor was determined upon the nature of the interior brickwork of the sewers heretofore constructed in Washington?

MR. MCCOMB: The coefficient .013 has been used for many years (about 20) and it has been considered as representing the friction of ordinary brickwork. We believe that the materials which we are now using in the inverts give smoother surfaces and would permit a reduction of the coefficient. We have not gone far into this subject and have not determined the proper coefficient for use. We consider that we are using a larger coefficient than is necessary but feel that we err on the side of safety.

The amount of drainage to be provided for in the project of the Sewage Commission was fixed by the use of a curve, which approximates a curve used by the office; this gives a rate of flow from areas of sixty acres of two inches per hour and diminishing for larger areas, so that when twelve hundred acres is reached the rate becomes one inch per hour; when applied to smaller areas, that is below sixty acres, the rate increases and becomes three inches for ten acres. For all areas below ten acres the rate of three inches is used.

These rates represent the amount of drainage assumed to reach the sewer. We have rainfall records indicating rates of five inches and over.

MR. HATTON: I should like to ask a question on an interesting point. It is one which has excited the attention of sewer engineers throughout the country. That is as to the mechanical device by which intercepting sewers are controlled during times of storm. There are a number of devices used throughout the country for that purpose, and Washington being in the front with all progressive movements, I should suppose that you would be ahead of us in the race on that point. I should be glad if Mr. McComb would explain to the Association the mechanical device by which he performs this work.

MR. MCCOMB: The use of controlling devices is prospective; we have none of these devices in service.

MR. AMES: I should like to ask if the sewage is to be discharged at the bank of the river, or to be dumped into the river.

MR. MCCOMB: The sewage is to be discharged into the river through a gang of pipes which will be submerged.

MR. AMES: Into what depth of water?

MR. MCCOMB Into about eight feet of water. That is the intention, though this detail has not been gone into very fully.

THE PRESIDENT: I should like to inquire of Captain Beach, as to the width of the Potomac at the place of discharge, and also what is the rise and fall of the tides.

CAPTAIN BEACH: The rise and fall of the tides is a trifle less than three feet for ordinary tides. The Potomac varies considerably in width. The exact point at which discharge will take place has not yet been definitely determined. It will probably be at a point down opposite or near Alexandria. As Mr. McComb has told you, that part will probably not come much before 1925, and we have not done much yet toward selecting the exact spot. As you will all notice when you go down to Mt. Vernon on Friday afternoon, really from here down to Chesapeake Bay is only a large arm of the Bay. The amount of water which comes from the upper Potomac above Washington is very small compared with the volume of the river below Washington, and you will find that the river varies greatly in width at high and low tide, there being a well marked channel flanked sometimes on one side, sometimes on the other, and sometimes on both sides, by quite extensive flats, so that the width of the stream is rather an indeterminate quantity.

MR. ALLEN: I should like to ask whether there would be any danger of sedimentation occurring on those flats which may be uncovered at certain stages of the tide and wind.

CAPTAIN BEACH: The flats below the city are seldom bare. At low tide the grass merely comes to the surface. Of course that has been taken into account. The matter will be watched closely, and if there is danger from that source we should have to resort to some method of relieving the sewage of its worst features, and preventing that nuisance occurring.

MR. ALLEN: I should like to ask Mr. McComb about the cost of concrete sewers as compared with brickwork. I understand they use concrete a good deal in Washington.

MR. McCOMB: The ratio is about 7½ to 9; that is about 7½ for concrete masonry and 9 for brickwork.

MR. ALLEN: For the larger sewers.

MR. McCOMB: No, that is for ordinary work.

MR. HEWSON: I should like to ask Mr. McComb a question. I understand the rise of the tide here is about 3 feet.

MR. McCOMB: About 2 feet 11 inches.

MR. HEWSON: Now, how far is the contemplated point of discharge from the central front of the city of Washington? As I understand it, the discharge would be at Alexandria?

MR. McCOMB: No, it is to be very nearly midway between the two cities.

MR. HEWSON: What is the distance from the central point?

MR. McCOMB: It is about seven miles from Washington to Alexandria, and about three miles and a half to the point of discharge.

MR. HEWSON: Does the tide flow up beyond the city of Washington?

MR. McCOMB: The point was selected because it was a point at which the sewage might be discharged without reaching Washington by the incoming tide.

MR. HEWSON: That is the tide then at that point loses its force and commences to ebb?

MR. McCOMB: Yes; at about that point. We have the increment of the fluvial discharge of the river coming down all the time, and that affects the conditions considerably, and flows the water down the river further.

MR. HEWSON: That is a very important point, because we have similar conditions at home, and it is still more important where there are flats which are more or less exposed at the ebb of the tide. These flats would receive sewage sediment if the sewage flowed back again in front of the city, reaching the point where tidal flow ceases. Probably there is no danger of that occurring in front of your city.

MR. McCOMB: There is not. There is a point below Georgetown, at which, while the tide rises, it does not flood. It is all ebb from that point out at all stages of tide. Now, as you go down from the city you will be reaching this point, which is such a point that the sewage, when it floods, reaches something below the city and below the south bank of the Anacostia River, upon the recurring ebb tide.

A MEMBER: I should like to ask Mr. Allen, in his proposed plan of the sewage of Baltimore, what he does with the storm water. I do not understand about that. How much of that is taken into the sewage system?

MR. ALLEN: None of it. It is all intended to be kept out. As I stated, the city has some storm water sewers and they are all of very large size and well built, especially the more recent ones, and they would probably be extended as the case required. The sewage there will either have to be treated or else taken a long distance, 12 to 13 miles.

A MEMBER: Will not the flooding from the rains when a rain starts, be about as bad as any other sewage?

MR. ALLEN: Well, it would be about as bad as the sewage during the first of the storm; but it would go out into the harbor and be removed by a moderate amount of dredging.

A MEMBER: What would be the effect on the oysters?

MR. ALLEN: As far as the oysters are concerned, I do not think it would be as bad for the reason that storm water sewage would not be likely to contain the bacteria of typhoid fever, &c. There is one other thing that I should like to state with regard to the float experiments we made. The first observations were made for us by the courtesy of the U. S. Coast Survey, which had a vessel stationed there for a few days, and they found that floats set out about 2 miles northeast of North Point and a mile off shore at the beginning of the ebb would, on the flood, round the point in the direction of Sparrow's Point, and it was feared that there would be objection to that; so we located our discharge point farther up. It was fixed at such a point that when the sewage was discharged at the beginning of the ebb it would come down opposite North Point, then at the flood it would turn towards the shore and tend to pass up parallel with the shore until the next ebb would take it out and down the bay. It was rather a curious, unlooked-for circulation of the currents. It tended to rotate as in a circle, first down-stream, then towards the shore, and then out and down again—something which could not have been foreseen without actual experiment.

A MEMBER: I want to ask Mr. Allen as to the floats, whether they were of different lengths and depths, and whether the length had any effect on the velocity?

MR. ALLEN: We did not notice any particular difference in the velocity. We had some six feet long and up to eight feet and a half. We tried to use a float as long as possible that would not ground. There was a shoal which the current tended to pass over, and for that reason we found that a seven foot float was probably about the most favorable for our use, and most of them were that length towards the end.

A MEMBER: Were they affected by the wind?

MR. ALLEN: Not apparently, they would go right against the wind.

MR. HATTON: I want to ask Mr. Phillips a question. He read an article or paper very favorable to the automatic flushing system. I have constructed a good many flush tanks of various kinds, and have seen all the different kinds on the market, I think, and tried them without success. I am very anxious to know what success Washington has had in the way of flush tanks. I have not found them reliable without close inspection. If the city of Washington has had success in the use of them I should like to know, and I think members of the association would like to know it. I suppose we have nearly all of us used them with varying success.

MR. PHILLIPS: The city of Washington has now about one hundred automatic flush tanks located on lateral sewers that do not receive storm water at their dead ends. They require, of course, a regular inspection, some slight adjustment and occasionally some repairs, but they otherwise work satisfactorily. Some of the tanks were constructed, I believe, as long ago as 1893, and perhaps earlier. A large percentage of them have been in use three years or more. In some cases they have been found to work satisfactorily without any expense at all for repairs. Of probably fifty per cent. of them this is true, or perhaps hardly as large a percentage. The others have required some little attention but no considerable expense in the way of repairs. The common trouble is due to the stoppage of the inflow pipes on account of the water being turned down to such a small driblet to give the interval of discharge we usually have, which is about thirty-six hours, and to siphons leaking. When the gentleman says they have not been a success I presume he refers rather to their maintenance and the expense of maintenance than to their efficiency.

MR. HATTON: Yes.

MR. PHILLIPS: Of course, they require regular inspection and some attention, but beyond that they have been successful.

CAPT. BEACH: Are any of them made with movable parts?

MR. PHILLIPS: Yes, I think we have a few of the Van Vranken type, perhaps two or three. Most of them are of the type of siphon without movable parts, such for instance as the Rhodes, Williams and the Miller siphon, and these have been found to work, I think, very satisfactorily.

MR. ALLEN: About how many are there in the city.

MR. PHILLIPS: About one hundred.

MR. ALLEN: Are you still putting them in?

MR. PHILLIPS: Yes, there are not many of them required, of course, on the combined system. They are put, as you see, on the dead ends of sewers which do not receive storm water.

MR. ALLEN: I think the point you brought out about the volume is very interesting and very important. In reading about the European works it is noticeable how many of these systems have very large flush tanks, while in this country they have very few. I think that where sewage reservoirs can be constructed they are very much better than small tanks.

MR. BENZENBERG: I wish to ask Mr. Phillips a question on that very point. You have given the result of flushing for a distance of nearly a thousand feet with something like six hundred gallons, am I correct?

MR. PHILLIPS: Yes; nearer six hundred and fifty gallons.

MR. BENZENBERG: Have you on that same line of sewer made any experiments with a fifty or forty cubic-foot flush to ascertain what the results would be for a given distance? Of course, sewers are sometimes united with others and it may not always be necessary to have the flushing continue for a distance of a thousand feet. I thought perhaps you might have made some experiment showing what the results would be on the same sewer under similar conditions with a forty or fifty cubic-foot flush?

MR. PHILLIPS: That has not been done at all. These observations have been taken on lines where flush tanks had been already constructed and merely with a view to discovering to some extent their relative efficiency, but the line in question has no lateral sewers coming in. The ordinary flow is indicated somewhat by the velocity given in the second diagram and is quite small. We have not attempted either in this case or in any of the others to determine what the effect of smaller flushes would be. There have been quite a number of experiments made, however, which indicate to some extent what the effect is; but altogether on smaller sewers, I believe. It would be well, perhaps, to call attention to the fact that these sewers are all twelve inches in diameter, while tanks have been often placed on sewers as small as six inches in diameter, and are generally placed on eight-inch sewers. This question of the relative effect of different volumes of discharge is a most interesting one and deserves investigation. But, as has been stated, no such observations were made because the effect of a constant discharge on different grades was sought, and opportunity at this time did not permit extending the inquiry.

MR. SHERRERD: This paper has been interesting, not only from the point of sewer construction but also that of the management of water plants in the different cities, and I have been very much interested in the results, showing the absurdity of constant flushing with a small amount of water. Our trouble has been that almost all the flush tanks constructed with movable parts have gotten out of order entirely, so that practically no flushing occurred, a constant little dribble of water running down the sewers without doing any good. It seems to me that this discussion has been important as showing the utility of a good flushing which need not be very frequent.

THE PRESIDENT: The next committee report is that on "Water Works and Water Supply." Mr. M. L. Holman, of St. Louis, is chairman of that committee.

MR. HOLMAN: Mr. President and Gentlemen, your Committee on Water Works and Water Supply, as usual, through stress of other business and the widely distant residences of the members, have been unable to prepare any formal report. In a short conference, held this morning between the other member of the committee and myself, we came to the conclusion that the topic most suitable for this meeting, as being most general in its bearing, was "The Water Supply," and the protection of it.

That subject divides itself into two branches, one being the source of supply, the natural source furnished by the country, principally rivers, and the other is the treatment of that supply and the protection of the public through it.

The protection of the source of supply from contamination must be soon taken up in this country—not by any municipality as a local problem, nor by the State as a State problem, but by the general government as a general governmental problem. The subject forces itself upon the people of this country more strongly in the East than it does in the West. In the West we are only beginning to settle the country, and the matter has not given us any bother as yet. In the East it is now a serious question.

It was my good fortune last year to be afforded an opportunity to investigate both of these subjects in another country, a country much older than ours, much more thickly settled, and where, you might say, they had got down to bed rock. They have found it necessary, not only to protect their water supply, the water which nature has given them, from pollution, but have also found it necessary to protect their people by a treatment of those waters, a treatment which has been peculiarly successful in that country and well adapted to the conditions existing there. It may be of some interest to you if I explain, without unnecessary detail, the matter as practiced and handled by the engineers.

It consists simply in building a filter, which is a small basin. In that basin there is built up a sub-structure, and a bed of sand, about three feet thick. This sub-structure and bed of sand are for the purpose of forming a support for the material which afterwards effects the purification of the water. This material is formed from the water itself; it forms on the surface of the sand and penetrates it slightly. It is a bacterial formation, and is known as a blanket, a film or a veil. The water, in passing through this veil at a slow rate, is deprived of its bacteria. The national health authorities established a standard of purity at one hundred bacteria per cubic centimeter. In actual practice in large municipalities a standard of purity of fifty-five to sixty bacteria per cubic centimeter is maintained. The work of purification is performed by the bacteria themselves. The water is carried through the film at a velocity not exceeding 125 millimeters per hour.

It was found in Bremen, where they have a highly contaminated water supply, that one filtration was not sufficient to purify the water to the extent required. So they there gave it a double filtration, first passing it through one filter, and then through a second filter. The matter of peculiar interest in that connection is that in order to build the film on the second filter they have to take the raw polluted water from the river. The water, after passing the first filter, is freed from a large number of bacteria, and does not build a film for the second filter within a reasonable time. With double filtration they handle the water successfully.

That, in brief, is the general system of sand filtration. Some filters are covered and some are not.

There is another system practiced in Germany, which simply consists in making the sand of a natural filter, to stand on edge.

In other respects the causes and results and velocities are the same, and the head used is the same. The film in this case is built up on sand that stands vertically. This gives an output per acre of land about eight times greater than the horizontal sand filter.

The cleaning of this sand plate filter is produced by the reversal of the filtered water back through the filter. The veil, lying lightly on the sandplate, when the water is reversed the film is not completely destroyed, so that the forward filtration may begin at once. In the horizontal filter, when the film is removed, it takes from three days to two or three weeks to again build the veil up so that forward filtration will be successful.

That, in brief, is the process of natural sand filtration as used in Germany, where it has been used so successfully that millions of population have been protected.

The waters of Germany, coming from a highly cultivated soil, are contaminated organically. There is very little or no inorganic matter in suspension, though there is in solution. In Hamburg the water runs at times as high as 3 per cent. of salt, in consequence of the drainage from the salt mines above.

In Holland, where they have to contend with waters that carry clay, the coagulation process has been used successfully.

The engineers whom I consulted assured me that it was useless to try the horizontal sand filter in the waters of our Western rivers.

I would suggest, Mr. Chairman, that the most appropriate body to take under consideration the advisability of beginning a movement along a line which will result in the protection of our rivers by the general government, is this society. I am well aware that efforts have been made along local lines, but this, being a matter of national importance, I think should be taken up by the national government, for the purpose, first, of studying existing conditions; secondly, the proposed remedy, and third, the enforcement of that remedy by the national health authorities for the protection of the people.

The question is one that will force itself upon us sooner or later. If we are ahead of the necessity, we protect our population and save ourselves a large expense. If we stay behind, we will have to pay the bills. (Applause.)

MR. SHERRERD: As Mr. Holman has said, the question of having the national government take up this subject would seem to be an important matter to be considered by a convention of this kind.

Mr. Holman has described very thoroughly the methods pursued abroad; and thinking over the subject, I have been reminded of the conditions which exist in and around the metropolitan district. The getting of waters for the different municipalities, some of which are now part of greater New York, brought up the question of utilizing streams which flow through two States; and in procuring a water supply for some of the municipalities of New Jersey the same question is involved, that is, either diverting the head waters of a stream which flows into New Jersey (taking that for an example), or of taking water from a stream in New Jersey which has its source in New York State.

The great difficulty in these situations has been the control of the stream, not only as regards the prevention of pollution, but as regards the legislation necessary in order to procure the rights for the construction of reservoirs or for the diversion of water from water powers. This is one of the questions which has led the Water Works Committee to bring the subject to the attention of this society. Such a question, affected as it must be by the laws of different States, cannot be handled by the courts as now constituted. The right of eminent domain is granted to municipalities by the State in which the municipalities are located; but they have no right to go outside of that State. If the subject were taken up on broad lines and some action or legislation by the national government procured, it would solve the problem to a great degree.

There is one other question, in connection with the pollution of streams, which has been forcibly brought to the attention of the same district—how far the taking out of the natural flow of the stream, particularly at low stages of water, increases the percentage of pollution. This question has become so important along the Passaic that one of the large water companies which has been diverting water from the head waters has been indicted in one of the counties further down, and by one of the municipalites, on the ground that the water diverted for the use of municipalities has decreased the summer flow to such an extent as to cause a nuisance all along the lower regions of that stream. If this contention is maintained in the courts the question of any municipality securing a water supply from the head waters of a stream becomes a very serious problem as regards the amount of money that must be paid for damages. Not only will it be necessary to pay for the sites of reservoirs and pay for the diversion of water from the water powers, but each individual owner of property along the stream will have to be paid in order to recompense him for the depreciation of the value of his property or for the damages incurred by reason of pollution.

I believe that some action by this society, as suggested, should be taken.

THE PRESIDENT: Are there any further remarks on this question?

CAPT. BEACH: Mr. President, if there are no other remarks on that subject I should like to state that the papers to be presented to-morrow afternoon on the subject of street paving are quite numerous, and there are some other subjects that will be presented. The discussion, as we know by previous experience, is generally greater on the subject of street paving than upon any other. Mr. Richards, assistant engineer of this city, has a paper, which is on the list for to-morrow afternoon, on the subject of tree planting in the city of Washington. Mr. Richards is here this evening and [illegible], and if it meets the pleasure of yourself and the other members of the society, I think it would be well to have that paper presented this evening instead of to-morrow afternoon.

THE PRESIDENT: The Chair thinks the suggestion of Capt. Beach is a good one. It is yet early in the evening, and we only have on the programme the matter of selection of committees to nominate officers and to select a place of meeting next year.

CAPT. BEACH: Mr. Richards' paper is rather short.

THE PRESIDENT: If there is no objection we will now listen to the paper by Mr. Richards on tree planting in Washington.

MR. WILLIAM P. RICHARDS read the following paper:

TREE PLANTING IN THE STREETS OF WASHINGTON.

BY WM. P. RICHARDS, WASHINGTON, D. C.

The selection, planting and care of all trees in the streets of Washington is under the direction of the District authorities. Individual preferences or private enterprises are not allowed to regulate this improvement, as is generally done in other cities. Moreover, the city has its own nursery, where seeds planted from its own trees grow and supply all the needed varities.

In 1871, during the era of great municipal improvements, Governor A. R. Shepherd appointed a commission to regulate this important matter and their efforts have brought about the beauty and uniformity of shade existing in Washington to-day.

This commission acted in an advisory capacity and served without pay. the first one appointed being unchanged for twenty-five years. Its members were Mr. Wm. R. Smith, Supt. of the Botanical Gardens, Mr. Wm. Saunders, Supt. of Agricultural Grounds, and Mr. John Saul, a local nurseryman. During the last thirteen years Mr. Trueman Lanham has acted as chief executive officer of the commission, or Supt. of Parking.

Under the guidance of these men tree planting has never been at an experimental stage, but an undertaking so great has, of course, had its lessons of experience. The qualities of a good curbstone tree were set forth in the annual report of the commission in 1872 as follows:

"First. A somewhat compact stateliness and symmetry of growth, as distinguished from a low spreading or pendant form, so that the stem may reach a sufficient height to allow free circulation of air below the branches.

"Second. An ample supply of expansive foliage, of bright early spring verdure, and rich in the variety of colors and tints assumed during autumn.

"Third. Healthiness, so far as being exempt from constitutional diseases, as well as by maladies frequently engendered by peculiarities of soil and atmosphere impurities.

"Fourth. Cleanliness, characterized by a persistency of foliage during the summer, freedom from fading flowers, and exemption from the attacks of noxious insects.

"Fifth. It should be easily transplanted, of moderately vigorous growth, and not inclined to throw up shoots from the roots or lower portion of the stem. A tree of extremely rapid growth is generally short-lived.

"Sixth. The branches should be elastic rather than brittle, that they may withstand heavy storms; and lastly, there should be no offensive odors from foliage or flowers."

Of course, no tree planted amid the artificial conditions found in a city will fill such rigid requirements. This report of 1872 recommends as best the Silver Maple (Acer dasycarpum), the American Linden (Tilia Americana) and European Sycamore Maple (Acer Pseudo-platanus). The American Elm (Ulmus.Americana) is thought to fill all the requirements when not subjected to the attacks of insects. The Tulip Tree (Liviodendron Tulipifera), Sugar Maple (Acer Saccharium), Sweet Gum (Liquidamber straciflua) and the Red Maple (Acer rubrum) are named as the most beautiful of trees, their only drawback being that of not growing freely after transplanting. The Norway Maple (Acer platanoides), the Negundo (Acer negundo) and the American Ash (Fraxinus Americana) are recommended for certain places. For wide avenues, the Buttonwoods (Platanus Occidentalis and Platanus Orientalis) are considered rapid-growing and effective trees.

Of late years some varieties have been planted that are not mentioned in the above, and others, once common, have been pronounced as poor street trees.

Washington was a city of young trees during the seventies and in the spring of 1873 more than six thousand trees were planted, consisting of Silver Maples, Norway Maples, American Elms, American and European Lindens, Sugar Maples, Tulip Trees, American White Ash, Scarlet Maples, various Poplars and Ash-leaved Maples.

From 1880 to 1888 the caterpillars were extremely numerous in the city and opportunity was had for observing which trees were mostly a prey to them. It was found that the White Poplar and the Negundo or Ash-leafed Maple were the first to be attacked and next the Lindens, Elms and Sycamores (or Western Planes) and White Ash. Those mostly exempt were the Carolina Poplars, the Sugar, Silver and Norway Maples, the Tulip Tree and the Honey Locusts.

A careful count was made of the trees in 1887, and by comparing this with the number since planted and those removed, there is found to be more than 78,000 trees, which if placed thirty feet apart would line both sides of a boulevard between Washington and New York. These consist of more than thirty varieties, but seven-eighths of the number may be placed in less than twelve varieties. The number, location and peculiarities of the principal trees may be best described separately.

The Silver Maple (Acer dasycarpum) numbers about 25,000, or nearly four times any other variety. It is almost a perfect street tree, as it stands transplanting well, is a quite rapid grower and has beautiful foliage, which is never too heavy to allow free circulation of air. It loves moisture, but nevertheless stands seasons of drought better than many others. It cannot attain at the curb stone the magnificent proportions that it has in the park or field and must be trimmed at times very severely.

It is seldom attacked by the caterpillar, but some years ago a scale appeared on the trees that caused serious thoughts of their removal. This has since disappeared and the trees are in a healthy condition. It taught the lesson, however, that it is well not to have most trees of one variety. The most recent plantings of the Silver Maple may be seen on S street, and good examples of severe trimming on 3rd street, N. W., and on T street, N. W., from 3rd to 5th streets.

The Norway Maple (Acer Platanoides) numbers about five thousand trees and it is unfortunate that more of them were not planted in past years. They require considerable care in transplanting and are a little too thick in foliage. They are handsome in leaves and form and are of strong fibre, so that they withstand storms well. Insects seldom trouble them.

Two splendid rows of them may be seen on 8th street, N. W., above G street; on 16th street, N. W., above H street, and on 13th street, N. W., above K street.

The American Elm (Ulmus Americana) numbers about 5,000 trees, planted on various avenues. It is a tree of spreading form so that on roadways fifty feet wide its limbs arch the entire space. From this it is liable to be split by storms. It presents a magnificent appearance at certain times of the year, but the Elm leaf beetle has preyed so constantly on this tree that it is either doomed to disappear as a street tree or else be limited to a small number. New Jersey, New York, New Hampshire and Rhode Island avenues are planted with this tree.

The Buttonwood Sycamore or Plane Tree (Platanus Orientalis and Occidentalis) number 5,000 trees. It is a tree of large growth and must be closely trimmed as a street tree. The Western Plane is not an altogether handsome tree, its shedding of bark giving its trunk an ugly appearance, which is objected to by many. As a shade producer it has no fault. The Eastern Plane is its superior in many respects, and it seems unfortunate that its merits were not recognized sooner. Its size and nature makes it better fitted for avenues than the narrower streets. Its foliage is splendid in appearance and of the proper thickness. It is free of insects. If the Elms were replaced, in part at least, by this tree much would be added in way of ornament to the city. Good examples of the Western Planes may be found on 11th street, N. W., 10th street, N. E. The Eastern Plane is best seen on Indiana avenue and at the Peace Monument. A magnificent specimen stands in the center of Lincoln Square on East Capitol street.

353907

The American Linden (Tilia Americana) numbers five thousand. Most of them are on Massachusetts avenue, which has four rows nearly four miles in length. In early summer they are at their best, when their flowers fill the street with their fragrance. They need ample space and are apt to suffer much from the drought. They seem to have been planted too close in this city and have grown very little in late years.

The Tulip Tree (Liriodendron Tulipifera) numbers nearly two thousand. It can hardly be considered a good curb stone tree, as it requires good conditions in its development. It is fine in appearance and does well on wide parkings, as on 16th street, which it occupies jointly with Norway Maples, the later along the curb.

The Carolina Poplar (Populus Monilifera) numbers about six thousand and was probably planted on account of its rapid growth. It is a good curb stone tree in many respects, is assertive, free of insects and of good foliage. Its bad qualities are brittle limbs, which are always broken by storms and a presistency of root growth that is fatal to sidewalks. Money considerations have doomed them and they are being replaced with more desirable trees.

The Aspen Poplar (Populus Alba) and Ash-leaved Maple (Acer Negundo), numbering about two thousand, although of good foliage, have been condemned as street trees on account of their liability to attacks of insects.

The Ginkgo or Maiden Hair Tree, although few in number here, has been found to be a good curb stone tree. The Pin Oak, planted in the parking on East Pennsylvania avenue, has shown itself an ideal tree for an avenue or widely parked street.

The Catalpa, along the same avenue, will be removed in the near future. Horse Chestnut trees have been grown with some little success on 13th street, N. W., but cannot be called a good street tree.

The Sugar Maple, although a queen among trees, needs too good care for an ideal street tree. No success has been had in this city with it, although it may be said that attempts have not been persistent. A fine specimen stands in the parking northwest of Thomas Circle.

The Red Oak planted on 12th street, where surrounded by good conditions, has been a great success.

If required to arrange a list of the trees in this city in the order of their merit and in the light of what has been here shown, I should place the Silver Maple, Norway Maple and Eastern Plane side by side in the first rank. Then the Ginkgo and Western Plane and last those that require extra care and are well fitted for wide parkings, the American Linden, the Oak and Sugar Maple.

The planting and care of trees in Washington grows from year to year and the future will probably demand more skill and judgment than in years past. About $20,000 is spent annually, most of it in the care of old trees. From one to three thousand young trees are planted during the spring and fall of each year. The nursery has several thousand trees of the best varieties ready for planting. After two or three years as seedlings and four or five years in the nursery rows they are taken up with no dirt to their roots and placed on the street in holes, from which four or five cart loads of the original soil have been removed. They are then filled around with suitable earth and a box placed over for protection. These boxes are seven feet in height, 16 inches square at the bottom and 10 inches at the top, built of strips 1x3 inches. They are held by four stakes driven into the ground on each side in a slanting direction and nailed to the box. Leather straps are nailed to the top of the box and passed around the tree to prevent any injury to the bark by rubbing in windy weather. These boxes are not an ornament to the street, but are an absolute necessity for the protection of young trees. After the tree has gained sufficient strength the box is removed and a wire netting six feet long is fastened around the tree. It costs about thirty-five cents per tree and some forty thousand trees are protected in this way.

The proper distance to space trees depends on the locality and variety. Too close planting was done during the first year of the Commission, the distance along curb being from twenty to twenty-five feet. From thirty to forty-five feet is now considered better limits.

The trimming of trees is a bone of contention among authorities as to time, manner and extent. It is certain, however, that some city trees must be trimmed and trimmed severely at some time if they are expected to last long.

This outline is presented as a study of the history of this enterprise and some personal obeservations of late years. The experience of twenty-five years has not resulted in a unanimity of opinion in the Commission itself, as evidenced by a report signed by the three, one of whom had this reservation, "approved as to facts but not as to opinions."

I therefore beg to offer these facts and opinions, leaving others the privilege of making their own selection.

REPORT FROM THE COMMITTEE ON ELECTRIC STREET LIGHTING.

F. W. CAPPELEN, CITY ENGINEER, MINNEAPOLIS, MINN., CHAIRMAN.

TO THE AMERICAN SOCIETY MUNICIPAL IMPROVEMENT—GENTLEMEN:

Having had the honor for three years to be a member of your Committee on Electric Street Lighting, I am fully aware of the fact that it it a very difficult proposition to make a report this year that will be of as much interest as the reports previously made by Mr. Cabot, formerly the chairman of this committee. As Mr. Cabot stated last year, it is a very unsatisfactory task to obtain proper information through correspondence. But as this appears to be the only method, your committee, particularly Mr. Hunter, of Allegheny, and your humble servant, entered into correspondence with all the cities, some one hundred and eighty, which in 1896 answered the committee's inquiries. Your committee desired particularly to find out if any changes in prices per lamp per year had taken place during the last two years. It is therefore a pleasure to be able to report that reductions have been made in the following cities:

2,000 CANDLE POWER LAMPS.

CITY.	SCHEDULE.	Price in 1896.	Price in 1898.	Contract period before.	Contract period at present.
Boulder, Colo	All night	$108.00	$96.00	2	5
Greely, Colo	To midnight	150.00	93.00	5	1
Galesburg, Ills	Moonlight	135.00	75.00	..	1
Joliet, Ills	All night	100.00	90.00	..	5
Frankfort, Ky	All night	68.00	80.00	5	3
Keokuk, Iowa	Moon	68.00	75.00	10	5
Saginaw, Mich	All night	105.00	95.00	5	3
Minneapolis, Minn	All night	150.00	118.00	1	1
Minneapolis, Minn	Moon	125.00	100.00	1	1
Red Wing, Minn	Moon	144.00	90.00	0	3
St. Cloud, Minn	All night	120.00	80.00	..	1
Marshall, Mo	Moon	80.00	60.00	3	1
Fall River, Mass	All night	159.85	131.40	4	5
Worcester, Mass	All night	127.00	116.80	3	3
Omaha, Neb	All night	120.00	114.50	2	6
Glen Falls, N. Y	All night	109.50	91.25	3	5
Utica, N. Y	All night	127.75	124.00	2	5
Lorain, O	Moon	60.00	65.00	0	5
Philadelphia, Pa	All night	128.00	119.01	..	1
Dallas, Tex	Moon	90.00	75.00	3	1
Montpelier, Vt		78.00	43.00	1	3
1,200 CANDLE POWER LAMPS.					
New Haven, Conn	All night	109.00	98.55	3	3
Pittsfield, Mass	All night	100.00	95.00	..	Moon
Pittsfield, Mass	Moon	65.00	62.00	..	Moon
Cambridge, Mass	All night	115.00	100.00	1	1
Summerville, Mass	All night	120.00	110.00	5	0
Butte, Mont	Moon	168.00	144.00	0	3
Hudson, N. Y	All night	114.00	198.00	4	5
N. Tonawanda, N. Y	All night	78.00	84.61	5	1
Brooklyn, N. Y	All night	127.75	124.10	1	1
Watertown, Wis	Moon	66.00	55.00	2	3

It will be seen that an increase has taken place in four cities with a reducion of contract time while a reduction has been made in 27 cities, but not always has the contract time been increased.

For all the other cities included in the comprehensive table published by this society in the annual report of 1896 no changes have taken place, hence, it is useless to cause a repetition of said table to be printed.

Last year the Committee on Electric Lighting caused the statistics gathered by the General Electric Company of Schenectady to be printed in the annual report for 1897 without comment.

The averages that can be deducted from said report check very well in general with similar averages obtained from your committee's report in '96. But it will probably be rather surprising to you to learn that said General Electric Company's statistics do not, as far as can be found, contain the figures of cost, etc., pertaining to a single city owning and operating its own municipal plant.

It of course may be that the General Electric Company simply wanted to show contract figures, without bothering with statistics from cities owning their own plants. The following cities operate their own plants to-day:

PLANT.	No. lamps	Candle power	Schedule	Cost per year	Cost of plant	Cost of plant per lmp
Prescott, Arizona....	209	2000	Moonlight	$41.27	$35,000	$169
South Norwalk, Conn	100	2000	Moonlight	60.22	14,000	140
‡Jacksonville, Fla....	375	2000	All night	90.00	14.000	373
Blomington, Ill......	300	2000	Moonlight	60.00	83,000	277
Chicago, Ill..........	...	2000	All night	100.00	......	...
Champaign, Ill.......	72	2000	Moonlight	64.30	......	...
La Balle, Ill.........	98	2000	Moon light	46.00	12,400	126
Ottawa, Ill..........	133	2000	All night	57.50	......	...
Kendallville, Ind.....	60	2000	All night	30.00	8,000	133
Topeka, Kan........	184	2000	Moonlight	56,21	47,000	255
Emporia, Kan.......	57	2000	All night	108.00	......	...
Bangor, Me.........	152	2000	All night	45.00	40,000	263
Reading, Mass.......	158	1200	All night	65.00	35,000	221
Bay City, Mich.......	181	2000	All night	49,00	32,674	180
Detroit Mich........	1744	2000	All night	83.50	750,000	...
Savannah, Mo.......	26	1200	Special	37.78	12,000	461
St. Joseph, Mo.......	369	2000	Moonlight	57.00	92,000	249
Dunkirk, N. Y.......	75	2000	Moonlight	45.50	21,000	280
Fredonia, N. Y......	58	2000	Moonlight	42.00	......	...
Hamilton, O.........	216	2000	All night	75.00	100,000	463
Columbus, O........	390	2000	All night	74.50	......	...
Marietta, O..........	112	2000	Moonlight	39.00	18,000	160
Martin's Ferry, O....	100	2000	Moonlight	....	21,000	210
Tacoma, Wash.......	...	....	....	100.00	......	...
§Fort Worth, Tex....	68	2000	Moonlight	64.48	44,000	647

‡Also provides for 320 32 candle power incandescent lamps.

§Also provides for 400 32 candle power incandescent lamps.

Ottawa price includes 10 per cent. for interest and depreciation.

Bangor price includes 4 per cent. for interest.

Hamilton price includes interest and depreciation.

Fort Worth price includes 6 per cent. for interest.

The general prices given are, of course, very low, but it is very difficult to get the right information as to what is included in the price per lamp.

Of these cities the Detroit plant is the most conspicuous one and as probably not all of you have read The Engineering News' editorial comments on the Detroit Light Commission's last report, some of these deductions are herewith presented in the hope that the convention will discuss some of the most important features that are not generally as fully considered as they ought to be when municipal ownership of light plants is being advocated in various communities, viz: Interest, depreciation and taxation. These very features have received, probably, the most thorough consideration of any city in the country in the last contract for electric lighting between the City of Boston and the Boston Electric Light Company, and the comments of The Engineering Record of Oct. 1st upon the contract will be presented with the same object in view as suggested with reference to the Detroit plant.

THE SUCCESS OF THE DETROIT MUNICIPAL ELECTRIC LIGHTING PLANT.

(From Engineering News, Sept. 8th, 1898.)

"The city of Detroit, as most of our readers will recall, has made the largest venture in the way of a municipal lighting system of any city in the United States.

"The subject of municipal lighting has been extensively discussed and bitterly fought over during the past ten years. Advocates of municipal ownership have magnified the savings which they claimed would be made when cities ceased to rely on private companies to light their streets. The opponents of municipal ownership, on the other hand, have urged that the loss through incompetent and dishonest officials and employees, in the case of municipal plants, would leave the taxpayers in a worse state than when lights were secured by contract.

"TABLE I.—Investment and Output of the Detroit Municipal Electric Lighting Plant.

Year ending June 30.	1897.	1898.
Total investment*	$721,400	$771,297
Investment per arc lamp	337.88	293.69
Investment per incand. lamp	18.93	18.52
Plant capacity, arc lights	2,000	2,250
Plant capacity, incand. light	3,000	3,500
Av. arc lights actually operated	1,564	1,744
Same for incandescent	3,064	3,901
Total hours operated, arcs	3,790h. 55m.	3,786h. 20m.
Average hours operated	10h. 23m.	10h. 23m.
Total scheduled lamp-hours, arc	5,873,295	6,505,352
Total hours of out lamps	1,371	7,465
Total hours lamps actually burned	5,871,924	6,497,887
K-W. hrs, output, arc	2,716,628	2,975,019
K-W. hrs, output, incandescent	263,784	306,596
K-W. hrs output, total	2,980,412	3,281,615
Total coal purchased, lbs	15,032,230	17,075,525
Lbs. used per K-W. hour	5.01	5.23
Cost of coal per ton	$2.06	$1.97
Cost of coal per lb., cts	0.103	0.098
Cost of coal per K-W., hour, cts	0.516	0.513
Number of men employed	105	93
Total pay-roll for year	$76,394	$65,660
Total operating expense	110,141	99,713
Cost per K-W., hour, cts	3.696	3.038
Cost per lamp-hour, arc cts	2.3	2.2

---

*Exclusive of Belle Island.

"It is of no small interest, therefore, to see just what results are obtained in practice and see how they compare with those which were so confidently predicted a few years ago. The third annual report of the commission in charge of the Detroit lighting system is before us. It covers the year ending June 30, 1898. As this is the third year of the plant's operation, it may be safely assumed that it is now on a fairly permanent basis. Both machinery and employees are well broken in, and the plant is old enough for the item of repairs and renewals to represent something like a steady figure.

"To give first a little of the past history: The Public Lighting Commission of Detroit was created by the Michigan legislature in March, 1893. Its six members were appointed by Mayor (now Governor) H. S.

Pingree, with the approval of the city council, and under their direction plans and specifications were prepared and contracts were let for a new municipal street lighting plant. The first annual report of the commission, describing the construction of the plant, was reviewed in Engineering News of Aug. 13, 1896.

"Turning now to the report of operations for the third fiscal year, let us consider first the cost of the plant.

"On June 30, 1897, the total cost of the entire plant, excluding the Belle Island plant ($7,821), amounted to $721,400, or an investment of $337.88 per arc lamp, and $18.93 per incandescent lamp, there being at that time a plant capacity of 2,000 arcs and 3,000 16-c. p. incandescent lamps. For the fiscal year ending June 30, 1890, the figures for the same items, also excluding the Belle Island plant ($18,848), are: Total cost, $771,297; investment cost per arc lamp, $293.69; per incandescent, $18.52; using the maximum capacity figures of 2,250 arcs, and 3,500 incandescents.

"It may be said here that the investment in machinery, etc., which is included in the above total comprises 7 Peck boilers, 5 triple-expansion engines of 240 to 340 HP., 20 arc dynamos of 50 K-W. capacity each, 2-57½ K-W. arc dynamos, 3 Westinghouse engines, 3-35 K-W. two-phase incandescent dynamos, 1,842 arc lamps, 3,901 incandescent lamps, 5,210 poles and 394 miles of wire, and all auxiliary apparatus such as pumps, condensers, feed-water heaters, etc.

"In Table I, the figures for investment, output, etc., are given for both 1897 and 1898. It will be seen that the investment per lamp has been considerably reduced through the extension of the lighting system with little or no increase in the power station machinery, and that the operating expenses have been largely reduced. Table II shows that the economy has been chiefly effected in the item of maintenance, and in shop expense and the various items in the table will repay careful study by those interested in electric station economy. In Table III the operating expenses have been arranged as percentages of a total.

"It will be seen that the station operation and the items connected with maintaining and operating the lamps made up 66.48% of the total operating expenses during 1897, and 74.11% during 1898, or an increase of 7.63%, which was accompanied by a corresponding decrease in other departments. The total operating expenses given in Table II show a decrease from 3.696 cts. to 3.038 cts. per K-W. hour of output.

"TABLE II.—Operating Expenses for 12-Month Ending June 30, of the Detroit Municipal Lighting Plant.

CHARGED AGAINST	Total 1897	Total 1898	1897 Per K-W. hour.*	1898 Per K-W. hour.†	Difference Per K-W. hour.
Maintenance:					
Bldgs., track, dock, etc.	$ 810.71	$1,452.86	....	....	....
Steam plant............	2,544.64	2,331.16	....	....	....
Electric plant..........	1,461.29	3,041.19	....	....	....
Misc. tools, m'ch'y, etc.	546.63	725.17	....	....	....
Conduits...............	1,354.96	697.79	....	....	....
Towers and lamp posts.	4,056.26	2,092.38	....	....	....
Arc lamps..............	5,824.34	2,440.02	....	....	....
Lines..................	6,982.23	3,525.04	....	....	....
Total maintenance..	$21,581.06	$16,305.61	$0.00724	$0.00497	$0.00227
Executive:					
Sal. Sec'y and Electr...	3,700.00	3,799.92	....	....	....
Printing and Stationery	962.08	574.44	....	....	....
Store room............	1,219.71	1,145.61	....	....	....
Clerk's and office exp..	2,339.96	1,551.59	....	....	....
Civil engr'g and draft'g	1,731,54	1,399.01	....	....	....
Total executive.....	$9,953.29	$8,470.57	$0.00333	$0.00258	$0.00075
Station:					
Oils..................	1,445.55	1,058.16	0.00049	0,00032	....
Waste.................	250.68	212.67	.00009	.00007	....
Coal..................	16,717.15	17,857.72	.00561	.00544	....
Miscellaneous supplies.	2,396.29	954.50	.00070	.00029	....
Wages.................	19,966.69	22,004.39	.00681	.00670	....
Total station........	$40,776.36	$42,087.44	$0.01370	$0.01282	$0.00088
Lighting:					
Trimm'g and patroll'g.	23,256.76	20,628.71	....	....	....
Carbons...............	7,118.05	7,765.82	....	....	....
Incand. lamp renewals.	662.33	956.70	....	....	....
Incand. lamp expense..		453.16	....	....	....
Globes and nets.......	492.90	460.61	....	....	....
Miscellaneous..........	95.66	495.17	....	....	....
Belle Isle Park........	....	1,045.30	....	....	....
Total lighting......	$32,411.38	$31,805.47	$0.01088	$0.00969	$0.00119
Shop expense............	$5,207.79	$716.39	$0.00174	$0.00022	$0.00152
Injuries and damages....	211.50	327.70	.00007	.00010	.00003
Total expense......	$110,141.38	$99,713.18	$0.03696	$0.03038	$0.00658

---

*Total K-W. hrs. output, 2,980.412.
†Total K-W. hrs. output, 3,281,615.

"There was an increase for 1898 over 1897 in total output of 301,203 K-W. hours to operate 180 arc and 837 incandescent lamps installed during the year.

"It will be seen that the above figures do not give the total cost per lamp per year, which is the basis on which figures for street lighting are most frequently compared. We will ascertain this a little later; but first let us see what arc lamps cost the city when it secured its light by contract.

"The average number of arc lamps actually operated and the cost for each year from 1884 to 1894 is given in Table IV, which is reprinted from the report of the commission for 1896.

"Number of Arc Lamps and the Cost to the City from 1884 to 1894.

"TABLE III.—Percentage of Operating Expenses of the Detroit Municipal Lighting Plant, Charged to Each Department.

DEPARTMENT.	1898			1897			Difference in totals.
	Wages.	Stores.	Total.	Wages.	Stores.	Total.	
Maintenance......	15.13	4.45	19.58	11.84	4.51	16.35	3.23‡
Executive.........	8.06	.96	9.02	7.69	.83	8.50	.52‡
Station............	18.95	18.09	37.04	22.07	20.14	42.21	5.17§
Trimming.........	21.61	7.83	29.44	22.07	9.83	31.90	2.46§
Shop.............	4.13	.60	4.73	.51	.20	.71	4.02‡
Injuries & damages	.01	.18	.19	....	.33	.33	.14§
Total.........	67.89	32.11	100	64.16	35.84	100	....

‡Decrease. §Increase.

TABLE IV.

Year.	Total No. of lamps.	Paid to Companies	Average per lamp.
1884...........................	24	$3,650	$150
1885...........................	300	71,982	240
1886...........................	382	91,571	240
1887...........................	565	115,490	204
1888...........................	608	117,370	193
1889...........................	702	128,063	182
1890...........................	719	137,937	192
1891...........................	1,031	133,717	130
1892...........................	1,168	152,283	130
1893...........................	1,279	164,831	129
1894...........................	1,279	169,360	132

"In April, 1893, bids were asked for lighting the city for periods of from one to ten years. The bids submitted by the local electric lighting company ranged from $154 per lamp for one year to $102.20 per lamp for ten years; $124 being the price asked for five years. If the ten-year agreement had been entered into, and if the number of lamps had increased at the same rate that actually did occur, Table IV should receive the following addition:

Year.	No. of lamps.	Addition total cost.	Cost per lamp.
1895	1,297	$173,538	$133.80
1896	1,483	151,562	102.20
1897	1,564	159,804	102.20
1898	1,744	178,236	102.20

"In ascertaining the present actual cost of Detroit's street lighting it is necessary to consider the matters of interest, taxes and depreciation, which are not included in the figures given in Tables II and III.

"The two previous reports of the commission have both been justly criticised, because in their computation of the cost per lamp these items were not sufficiently considered. Thus in the first year's report, interest on the bonds issued to build the plant was included, but no mention was made of taxes or depreciation. In the report for the year ending June 30, 1897, interest and taxes were fairly estimated; but depreciation, for some inscrutable reason, was figured on the boiler plant alone.

"In the 1898 report, however, all three items are included, and we find figures as follows:

Interest at 4% on $750,000, which is taken as the average investment	$30,000
Depreciation at 3% on $750,000	22,500
Taxes at $17.68 per $1,000 for city and $3.24 per $1,000 for state on $400,000, the estimated assessed valuation	8,368
Total	$60,868

"This proportioned on the basis of electrical output, gives $55,207 chargeable to arc lighting and $4,660 to incandescent lighting. Dividing the amount chargeable to arc lighting by the number of arc lamps (1,744), gives a cost of $31.65 per lamp per year. Adding this to the operating expenses of $51.85 per lamp per year and we have $83.50 as the total cost to Detroit per arc lamp for the year ending June 30, 1898.

"Does this represent fairly the actual cost to the people of Detroit, so that we can fairly compare this figure with the figures for contract service given above, or with the amount which other cities pay for electric lighting?

"Concerning the operating expenses, it will be generally agreed that these fairly represent the actual cost of running the works. The only thing which appears at all doubtful is whether the saving in maintenance account

f

has not been made by putting off to a more convenient day repairs and renewals, which ought to have been made to keep the plant in good condition. If this is the case, however, it will show in the expense accounts a year or two hence. The interest estimate is certainly fair, as the city can borrow money at 4%, the rate named. The tax allowance, too, will hardly be questioned by even the most rabid opponent of municipal ownership. When we come to the item of depreciation, however, dispute is sure to arise. Partisans of electric light companies will assert, we presume, that 7% to 10% is the least that should be allowed, and will instance the depreciation which has been experienced in every electric light station established prior to 1890 through the advent of improved machinery. But the past is not always a safe guide to the future. It is true that much of the machinery of ten years ago is obsolete now; but it is by no means certain, or even probable, that the same radical revolutions in electrical industry will be affected in the ten years to come. There was a time when progress in steam engine design was exceptionally rapid, and the old throttling low-speed engines were fast made obsolete by the automatic cut-off engines of the Corliss type. But at the present time there are many engines running which were built before 1880 and doing excellent and economical service, too.

"Let us see what a 3% allowance for depreciation means. It means that if 3% of the cost of the plant is laid aside each year and invested in a sinking fund, with interest at 4%, then at the expiration of between 21 and 22 years that fund will have accumulated to an amount equal to the cost of the plant. Of course, the plant itself will not be valueless at that time. A considerable part of it will be worth nearly as much as to-day, but we may fairly offset the value which it will then have against the increase in the cost of repairs which may be expected as the plant grows older.

"Now, the question is whether 21 years is too long a time to set for the average life of the plant. We are inclined to think that it is, and that a depreciation allowance of 4%, corresponding to an average life of a little less than 18 years, would be a more accurate estimate to determine the actual cost of electric light in Detroit.

"There is one other item which ought to be included in the Detroit plant's expense account to determine the actual cost, and that is insurance. True, the city does not insure the plant, and we do not question its wisdom in adopting this course. Nevertheless, the element of risk of loss by fire is as much an item in the cost of producing electric light as it is in any manufacturing industry.

"Suppose we allow an extra 1% for depreciation and 1% for insurance on the investment of $750,000, this will add $15,000 to the annual expenses, and will make the total cost per arc lamp per annum $92.10.

"It will be seen from the above that Detroit is certainly effecting considerable saving over what she would have expended had she accepted the bid of $102.20 per lamp, which was made in 1893 by the Detroit Lighting Company for a ten-year contract. A saving in round numbers of $10 per lamp per year means $17,440 per annum with the present number of lamps. On the other hand, it seems to be clear that the company, in making its bid, named about as low a figure as it could afford and leave itself a profit that would make the business worth doing. The company would have had to pay probably 6% interest as compared with the city's 4%, and it would have had to meet the contingency of failing to secure a renewal of the contract at the end of ten years, which would have left its plant on its hands. Thus it would have been obliged to figure on a much higher rate of depreciation than the citv.

"On the other hand, the company would have had the great advantage of doing commercial as well as street lighting; and this, it seems to us, is the weakest point in the operation of the Detroit municipal plant. It is evident on the slightest thought that to furnish electric light to a town or city, at the least possible cost, one concern should underake both the public and private lighting.

"As it is, the City of Detroit appears to be getting its street lighting done more cheaply than any private company would undertake that work, unless it were guaranteed a monopoly for a long term of years. Comparison with the prices paid in other cities also results in a favorable showing for Detroit."

Considering the prices in the table furnished by your Committee on Electric Street Lighting in 1896, we find the contract cost in 31 states for 2,000 c. p. lamp all night schedule to be $94.21, and according to the statistics furnished last year, taken from the General Electric Company of Schenectady, N. Y., the average contract price in 46 states was $101.18, and using the figures given in cities where reductions in prices have been made since 1896—viz: the contract price this fall—we have an average of $90. It will therefore be seen that Detroit compares favorably.

Detroit does not, however, compare so well with other cities operating their own plants; for, according to the figures for such cities, given previously, the average price for all night service, 2,000 c. p. lamps, is only $74.75.

These figures are, however, surely not absolutely correct as before stated; it is not known generally if taxes, insurance and depreciation and interest have been properly considered.

THE NEW PUBLIC LIGHTING CONTRACT IN BOSTON.

(From Engineering Record, Oct. 1, 1898.)

"The electric lighting of the streets and parks of Boston is mainly done by the Boston Electric Light Company, which, like every other similar corporation in Massachusetts, is subject to the jurisdiction of the Board of Gas and Electric Light Commissioners over the prices charged by it for public and private lighting. The company addressed a letter to Mayor Josiah Quincy a few months ago, calling attention to the fact that it was building a new station to replace all its plants not in the East Boston district. The machinery was about to be ordered, and it was necessary for the city to decide upon the class of lights it wanted before finally determining the type of dynamos which would be installed. This situation led to an agreement between the city and the company which contains many novel features, and, to a certain extent, makes the company merely an agent through which the city secures the electric lighting of its streets and parks.

"The present charges, 35 and 34 cents per light per night for street and park purposes respectively, are left as fair for the 2,365 lights now in service. But not only is a material reduction in the cost of lights provided for by a sliding scale as the number increases, but there is a further provision enabling the city to have the price revised by arbitration every two and one-half years, so that it shall not yield to the company, after it has met that portion of its operating expenses and depreciation account properly chargeable to its public lighting business, more than the actual return, not exceeding 6% in any event, which it pays on the capital invested in the business. If the company pays a larger dividend than 6% during the term of the agreement, it will have to come from the profits on private lighting.

"There are to be three arbitrators for this purpose—one appointed by the Mayor, one by the company, and the third selected by the first two. Their duties are clearly defined in the agreement and are largely of the nature of auditing accounts. Eight duties are specified. First, they are to determine the proportion of the total kilowatt-hours delivered by the company's plant which is used for public lighting. The City Engineer is given permission to make the necessary measurements and readings at any reasonable time, but the inspection is to be regarded as confidential and the results made known only to the Mayor. Second, they are to determine the total cost of the land and plant used by the company for generating and distributing the current. Third they are to determine the investment of the company on account of its public business; this is to be regarded as the same part of its total investment, as the station output for public purposes is of the total kilowatt-hours generated. In case all three arbitrators consider some other method of determining this amount fairer and more equitable, they may adopt it. Fourth, they are to ascertain the total operating expenses, including insurance, labor, fuel, taxes and all other outlays except payments on account of depreciation in excess of ordinary repairs. Fifth, they are to compute the operating expenses chargeable to the public lighting service in the same manner specified for determining the proportion of the total investment. Sixth, they are to estimate the surplus earnings of the company, which are to be considered its gross annual income, less operating expenses, interest and dividends. They are also to ascertain the percentage which the annual surplus thus determined is of the total investment, exclusive of land. Seventh, they are to make an allowance for depreciation in excess of ordinary repairs on account of public business. This is to be computed by taking the same percentage of the value of the company's investment on account of this business, determined as previously mentioned, but excluding the land, as the total amount of the undivided earnings, found as just specified, is of the company's total investment, exclusive of the land; but no such allowance shall exceed 7%. Eighth, they are to determine "an allowance for interest or profits, computed at 6% per annum on the company's investment on account of its public business, determined as provided in the third clause of this article. But in case the cost of any part of the company's investment shall have been met by the issue of bonds bearing interest at a lower rate than 6% per annum, and any of such bonds are still outstanding, the amount thereof shall be apportioned between the company's total investment and its investment on account of its public business, in the proportion to electrical output measured as provided in the first clause of this article; and the allowance provided for in this clause shall be computed on so much of the company's investment on account of its public business as is represented by said bonds at the rate actually paid thereon, and the remainder of its said investment at the rate of 6% per annum."

"In his message on this contract, Mayor Quincy states that the allowance of 7% depreciation on the whole investment, exclusive of that in land, was carefully considered before adoption and received the approval of the City Engineer. The company has not, in fact, been able in the past to set aside as large a percentage as this. The principle of making some sinking fund provision for a plant which becomes obsolete as rapidly as an electric lighting system is considered the only proper one, and the Mayor decided that sound public policy required the city to provide for a sufficient allowance for depreciation, rather than ignore this element of cost, with the result of compelling an unwarrantable increase in capitalization, tending to prevent the reduction in price which should naturally occur with increased business.

"Another unusual and important article in the agreement is summarized in the Mayor's message, as follows: "It practically compels the company to adopt such improved methods and apparatus as may in the future be anywhere put into successful use, as the arbitrators are, in fixing the price, to allow in favor of the city for any saving which could be effected by the use of such method or apparatus, were it adopted. The city, therefore, should be able to obtain every two and a half years the benefit of any cheapening which may occur in the cost of electric lighting."

"Such an agreement must, necessarily, run for a considerable time in order for the city to realize the benefits of a definite policy, and the period chosen was ten years, beginning February 20, 1899. Any City Council has the power to annul the contract, if it should become necessary, by declining to make the necessary appropriation for paying for the service.

"A secondary but important feature of the agreement is that the company is to substitute the new inclosed arc lights for the old open pattern, and to suspend them from wooden poles instead of mounting them on top of iron poles, as is now the practice. This is to be done without charge to the city, and will relieve it of an embarrassment under which it now rests, because of its failure to comply with a law passed in 1895, requiring the use of well insulated poles.

"The terms of this contract show a feeling of reliance by both parties on the integrity and fairness of each other which it is gratifying to witness in these days of frequent quarrels between city authorities and semi-public corporations. The company's willingness to place whoever may be Mayor and City Engineer during the next ten years in possession of its business secrets speaks well for the public officials of Boston, and is a tribute to the past and present Mayors and City Engineers which it is a pleasure to record."

Comparing the two editorials, viz.: The *Engineering News* on the Detroit municipal plant, and the *Engineering Record* upon the Boston contract, you will find ample food for reflection and discussion.

Engineering News thinks 3 per cent. depreciation rather small and favors 4 per cent. The Boston authorities have agreed that 7 per cent. on the entire investment exclusive of land is proper. *Engineering News* recommends the consideration of insurance. The Boston people have included this item in their agreement. Personally, the writer in his estimate of cost for a municipal plant in Minneapolis considered 6% a fair amount for depreciation, but did not consider insurance, which will hereafter be done, however.

The item of taxation charged against the Detroit plant is certainly, as the *Engineering News* states. eminently fair. Then take, for instance, Minneapolis. The General Electric Light Company of Minneapolis furnishes the city on one-year contract with 164-2,000-candle power all night lamps at $118, and 637-2,000-candle power moonlight lamps at $100, and does a great amount of commercial lighting. The company is now assessed as follows:

Personal taxes	$105,800
Real estate	8,850
Total	$114,650

On which is paid 23 mills in taxes, or a total of $2,636.95, as compared with $8,368 in Detroit.

In conclusion, your committee feels that a great deal of credit is due the American Society Municipal Improvements for the reduction in cost of electric street lighting throughout the country. Then, through the society, the information that has been gathered upon the subject has been brought right home to the various cities.

Thanking Mr. Hunter, of Allegheny, for his able and conscientious assistance in the committee's work, I remain,

Respectfully yours,

F. W. CAPPELEN.
Chairman.

REPORT OF THE COMMITTEE ON STREET PAVING OF THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.

COMMITTEE:

N. P. Lewis, Brooklyn, N. Y. (Chairman), Mem. Am. Soc. of C. E.
Edward B. Guthrie, Buffalo, N. Y., Mem. Am. Soc. of C. E.
George N. Ames, Grand Rapids, Mich.

To the President and Members of the American Society of Municipal Improvements:

GENTLEMEN:—Your Committee on Street Paving has not had the success in securing papers for presentation to the convention which it had hoped and expected.

The committee appreciated the fact that the subject of laying and maintaining pavements had been thoroughly discussed on previous occasions, and as it was not directed by the last convention to submit a report upon any particular subject, it was considered wise to try and present some new phases of the paving problem.

In the early part of the last summer a circular letter was addressed to members of the society in all of the cities represented, asking for papers upon the following subjects:

"1st. The selection of paving material; that is, what material is best suited for certain conditions, taking into consideration first cost, economy of maintenance, ease of traction, durability, sanitation, etc. This problem will, naturally, have different solutions in different localities, and under varying kinds of traffic; but a careful consideration of the special qualities of different paving materials should result in conclusions which will be of value and interest to the society.

"2nd. Railroad track construction in paved streets: The character of foundation, form of rail and kind of pavement best adapted for use in connection with tracks, having in view permanency of structure, with least possible disturbance of the surface for repairs, and a minimum of obstruction to the use of the street by vehicles.

"3rd. The obligations of street railroads and other corporations as to maintenance of pavements between their tracks, or over their subsurface construction. Would not more satisfactory results be obtained if railroad companies were to pay a fixed sum per mile of track per annum to the city, and the latter assume all responsibility for repairs and renewals?

"4th. Regulations to restrict and control the opening of pavements by corporations, plumbers and others."

It was explained that the committee did not wish to obtain descriptions of method followed in various cities unless these methods had special merit to recommend them, but was anxious to secure information which could not be obtained elsewhere, and which would be of real value to the members of the society.

While a number of responses were received to this circular, they nearly all stated that it would be impossible for the writers to prepare a paper.

The committee felt that there was no subject at the present time of more vital interest to municipal officers than the effect of street railway track upon pavements, and it has ventured to make this the subject of special investigation and report.

The relations between street railway corporations and municipal officers is too often hostile rather than friendly. In many of the older cities such corporations have been given franchises which impose few, if any obligations upon them as to the care of the pavements between their tracks. These franchises have usually been given in perpetuity, and the companies often seem to regard as an impertinence any criticism of the method of track construction, or of the condition of the pavement on the portion of the street occupied by them, while the suggestion that the company contribute even a portion of the expense of substituting a new pavement is so preposterous as to be ludicrous. Yet there is no problem requiring more patient consideration, or which should be taken up with a spirit of greater fairness, than this one of street railway track construction, the best kind of pavement to be laid along and between the rails, and its proper maintenance.

An insolent disregard of the rights of the public on the part of some few railway corporations is doing more to bring about partial or complete municipalization of railroads than anything else. The question of compensation for franchises, the quality of service given the public, etc., are not subjects which properly concern your Committee on Street Paving; but the method of track construction, the section of rail used, and the kind of pavement laid along and between the rails are proper and most important subjects for its consideration.

Early in August a circular letter was addressed to the officers of 28 of the most important street railroad companies in the United States. This letter requested answers to the following questions:

"What is your standard rail section? Is it a sidebearing, grooved or tee rail, and is the form prescribed by the municipal officers? Is there any reasonable objection to the use of a grooved rail, and are you permitted to use a tee rail in any paved street?

"Does your company lay and maintain the pavement between the tracks?

"On asphalt streets is the pavement carried to the rail on either or both sides, and, if so, do you find it difficult to maintain such pavement?"

"Do you favor the use of a tee rail in paved streets, and do you think that stone and asphalt pavement can be maintained along such rail?"

Your Committee wished to ascertain the views of the officers of important companies, known to be well managed, and to see whether or not they were disposed to attach proper importance to this question of paving in connection with their tracks. The information asked for has been received from 18 of the companies, and the general character of their answers will be seen from the accompanying tabular statement. The spirit of fairness manifest by most of the replies is gratifying, and indicates that the companies, as well as municipal officers, are devoting much attention to the problem of paving that part of the street used by them. The fact is becoming appreciated that as stated by the General Manager of the New Orleans Traction Company:

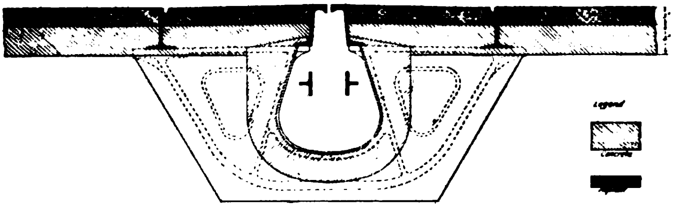
"In the construction of tracks in paved streets the pavement forms a large proportion of the expense, amounting in many instances to as much or more than the track construction proper, and as the stability of each depends largely upon that of the other only the best material and methods in track and paving construction should be used, and that each should be laid without respect to expense in the best possible manner, which will surely be the cheapest in the end."

Table showing rail sections favored by street railway officials and their opinions as to kind of paving most successful along tracks

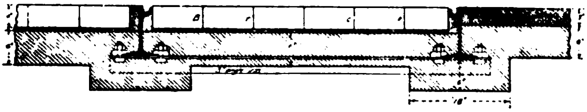
Railroad Company	Rail in General Use			Paving along rails on Asphalted Streets	Can asphalt be successfully maintained along rails	Objections to Grooved Rails	Is the Rail favored in paved streets if permitted
	Section	Height	Weight				
Albany Railway	Side bearing girder	9"	90 lb	Formerly granite toothing. Asphalt now carried up to rails	Yes	Snow & ice in this latitude fill groove	Yes
Binghamton R. R. Co.	Grooved	9"	—	Asphalt against rails for last two years	Yes,	None	No Experience
Brooklyn Heights R. R. Co.	Side bearing Girder and Grooved	9"	90 to 98½ lb	Asphalt along rails & stone toothing	On outside but not on inside of rails	Not found out, but it is more difficult to maintain pavement than with side bearing rail	Yes if permitted by City officers
Buffalo Railway Co.	Semi-grooved	9"	90 lb	Stone toothing	No	Snow ice & dirt would cause great trouble with full grooved rail	Would probably be successful, but not permitted
Cincinnati St Ry Co.	Grooved on cross ties and on concrete	6" to 9"		Asphalt along rails both sides	Yes	None	Not better than grooved rail now in use
Denver Consolidated Tramway Co.	Tee with grooved cross ties on concrete foundation	6"	72 lb	Stone toothing	No	No Experience. Tee much preferred	Yes. Under local conditions, gauge [illegible] and street rails
Detroit Citizens St Ry Co.	Grooved laid on concrete no cross ties	—	[illegible]	Asphalt outside Brick between rails	Yes on outside not on inside	None	No. Not better than section used and difficult to maintain pavement
Lincoln Traction Co.	Tee	6"	62 lb	Vitrified brick in all cases	No Asphalt in City	No Experience	Yes
Market St Railway Co San Francisco Cal	Side bearing Girder and Tee	[illegible]	[illegible]	Stone Toothing	No	Dirt makes rough riding - Nothing to recommend it	Yes, with good [illegible] stone along rails
Metropolitan Traction Co New York	Grooved, Girder with Extended Base	9"	107 lb	Asphalt along rails and stone toothing	Yes but repairs are frequently required	None, with extended base to carry wheels of vehicles	Not permitted nor favored
Nassau R R Co. Brooklyn	Side bearing Girder	9"	90 lb	Asphalt along rails & stone toothing	Only with difficulty	Impossible to keep track clean except with asphalt pavement	Yes
Washington D C	Grooved			Asphalt along rails both sides	Yes	None	
New Orleans Traction Co	Side bearing Girder	—	[illegible] lb	Stone toothing	No	Dirt in grooves requires more power & makes rough riding	Yes on streets wide enough to accommodate vehicle outside of tracks
Union R R Co Providence R I	Grooved adopted by R R Commission	9"	[illegible] lb	Asphalt against rails	with difficulty	No objections stated	Not favored nor permitted. Neither stone nor asphalt can be maintained along them
Toronto Railway Co	½ Grooved	6½"	[illegible] lb	Stone toothing. Asphalt against rail in some cases	No	None	Neither stone nor asphalt can be maintained along them
Twin City Rapid Transit Co Minneapolis & St Paul	Tee and on concrete no cross ties	7"	[illegible] lb	Asphalt tried but abandoned for stone toothing	No	Many objections but not stated	Yes
Union Traction Co Philadelphia	Side bearing Girder	9"		Stone blocks both sides of rail	No	Decided objections on account of difficulty in keeping clean	No except with very light traffic and brick pavement
West End Ry Co. Boston Mass	Side bearing Girder some Grooved	9"	90 lb	Stone toothing Asphalt against rails in some cases	Only with great difficulty	Object to use reasons not given. Obliged to use in some cases	Favored except for difficulty in maintaining any pavement

The railroad companies must understand that the privilege of operating their cars in city streets is a very valuable one, and that when they occupy the central half or third of the roadway (as is usually the case in the narrow streets of Eastern cities), they must expect to maintain the best class of modern pavement in thoroughly good condition. They cannot expect to treat a public highway, purchased and improved by the people, as they would a private right of way on which they have exclusive rights. The municipality must also understand that upon good transit facilities depend in a large measure the expansion and development of the city, and that a corporation which is disposed to give good accommodations and quick transit is a public benefactor, and should be given every encouragement and facility for improving its service.

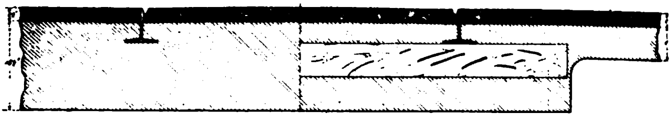
Repairs to track in paved streets are necessarily expensive, and every effort is now being made to build as substantially as possible. The laying of heavy rails upon a foundation of concrete, dispensing altogether with wooden cross-ties, is no longer an experiment, having been especially successful in Detroit, Denver, Minneapolis, St. Paul and Toronto. The methods of construction are shown on the accompanying sketches. As



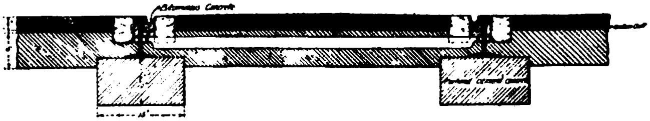
Washington D.C.



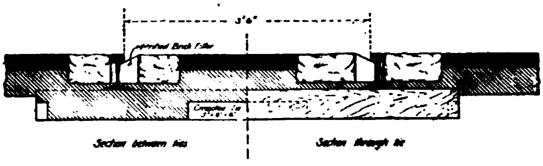
Detroit Mich.



Cincinnati O.



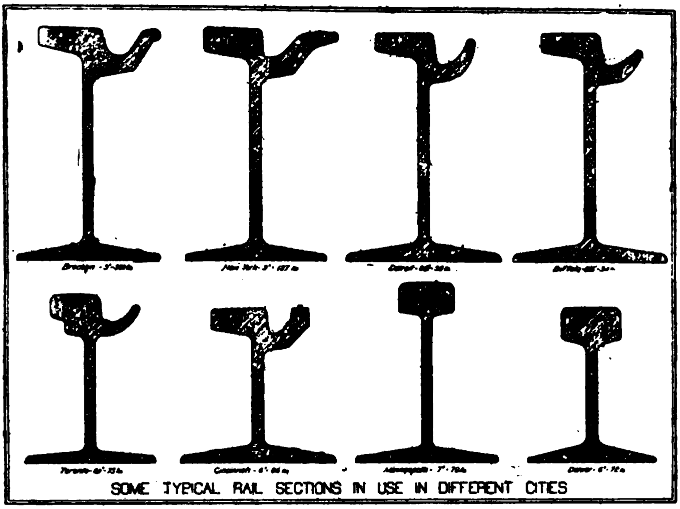
Minneapolis Minn.



Denver Col.

to the form of rail, there is considerable variation, and difference of opinion, though that most in favor among railway companies is the 9-inch sidebearing girder weighing 90 lbs. or more to the yard, though in several places where permitted by the law or the municipal authorities the tee rail seems to be in favor, while municipal officers generally prefer a grooved rail. Considerable opposition has been manifested by the railway companies to the grooved rail, but when its use has been insisted upon, they have soon accepted the situation, and find that there is no difficulty connected with its use. One railway official writes:

"We do not use any grooved rails for the reason that they are very poorly adapted to the street car business. * * * * * * In fact I know of no reason for the use of grooved rails anywhere, except that it is a fad of certain theorists who have no practical knowledge of the business, which, like other fads of the kind, such for instance as the narrow gauge for railways, must have its little day of popularity among the ignorant and inexperienced, to be finally cast aside as soon as the public have had experience enough with it to know that it really is."



SOME TYPICAL RAIL SECTIONS IN USE IN DIFFERENT CITIES

The tee rail would be deservedly popular were it not for the difficulty of maintaining pavement of any kind alongside of it, though in Minneapolis, St. Paul and Denver it is claimed that this can be successfully done. The question of pavement alongside of the rails (especially inside) in asphalted streets is difficult of solution. One of our replies says:

"It has been my experience in connection with railroads in different cities, that asphalt and street railroad tracks are hereditary enemies, and that brick or stone between the rails and the tracks and for a foot outside is a much better kind of pavement than asphalt."

Your Committee is disposed to agree with the sentiment that asphalt and street railroad tracks are hereditary enemies; but is convinced that with substantial track construction and the proper kind of rail an asphalt pavement can be maintained on both sides of the rail where the traffic is light, and that with the use of a toothing course along the inside of the rail where the traffic is heavy asphalt can be used on railroad streets as well as any other material.

After a careful consideration of the facts and opinions elicited by the letters received in response to their inquiries, and such personal investigations as have been made, your Committee would report the following conclusions:

Only the most substantial and permanent track construction should be permitted in important paved streets. The tracks should be laid upon a concrete foundation, metal cross ties being substituted for wood, resulting not only in greater permanency, but saving depth of concrete.

The best form of rail is the grooved girder, nine (9) inches in depth where streets are paved with stone, and 7 inches where paved with asphalt. In some cases where streets are very narrow, and vehicles are obliged to follow the tracks, the nine (9) inch side-bearing girder may be preferably selected, stone blocks of granite or trap being laid along the inside of each rail, and at the same level as the head of the rail. On exceptionally wide streets, where the traffic is not heavy, and will occasionally cross the tracks obliquely, but not follow them, tee rails may safely be used.

The pavement along the rails will depend upon that used on the remainder of the street. If the latter is of stone blocks, the pavement along and between rails should be the same, but in all cases should be of selected blocks upon a substantial concrete foundation, the joints filled with fine gravel and paving pitch. If of brick the same practice should be followed, the joints along and between rails being filled with similar paving pitch in whatever way the joints on the remainder of the street may be treated.

On asphalted streets the asphalt may safely be carried up to the back of the rail, and if full grooved rails are used, and the vehicular traffic is light, it may be carried entirely across the roadway. For heavy traffic the spaces between the rails and tracks should be paved with selected granite, or other hard, tough blocks laid on concrete with pitch and gravel joints. For moderate traffic a toothing course of carefully selected blocks, four inches wide and varying in length about three inches, but in no case more than ten (10) inches long, should be laid along the inner side of the rails, whether grooved or side bearing. These blocks may be laid in pairs of two long and two short, in which case the asphalt along them can be tamped more thoroughly.

In all cases blocks next to the rail should be bedded in rich cement mortar, rather than laid upon a sand cushion. The spaces under the head of the rail should be filled with fine cement concrete, leaving a vertical joint between this filler and the pavement, whether the latter be stone, brick or asphalt.

Openings made for repairs to track should be immediately restored before the stone blocks become injured, or the adjacent pavement or foundation disturbed. Such openings being shallow, this can always be done without danger of settlement.

THE PRESIDENT: Following the order of yesterday, we will listen to all the papers to be presented under the head of street paving and then have a discussion upon the papers afterwards. The next paper is entitled "The Cost of Repairs to Asphalt Pavements in Buffalo," by Edward B. Guthrie, now engineer of the Grade Crossing Commission of Buffalo.

REPAIRS OF ASPHALT PAVEMENT IN BUFFALO, N. Y.

BY EDWARD B. GUTHRIE, CHIEF ENGINEER, BUFFALO, N. Y.

On the general question of repairs of this class of pavement. I have but little to add to my paper on the same subject and read before this society in 1896. Having severed my connection with the City Engineer's office, and my attention being given to other subjects, I have but slight grounds for offering anything further, except possibly a mere statement of statistics to date, which might be of assistance to our members.

The field for study of asphalt under varying conditions is here a large one, where to January, 1898,

There have been laid	3,798,358 sq. yds.
Under city maintenance	1,782,512 sq. yds.
Under St. R. R. maintenance	102,550 sq. yds.
Under contractors' maintenance	1,913,296 sq. yds.

The method of repairing is the same as referred to two years ago, viz., by making an annual contract with a paving company to make the repairs at a certain specified sum per square yard, etc., actually repaired, and guaranteeing same for three years. These prices for the years 1897 and 1898 have been as follows:

	1897	1898
Re-surfacing per sq. yd	$1.46	$1.05
Skimming per sq. yd	.98	.64
Renewing concrete and surface per sq. yd	2.39	1.90
Painting gutters per lin. ft	.04	.02
Cleaning and pouring cracks per lin. ft	.02	.01
Replacing teething along St. R. R. per lin. ft	.19	.15

It will be seen that price of skimming has decreased in 1898 more than the other items, owing to which fact, and belief that resurfacing gives better results. I am told by Chief Engineer F. V. E. Bardol that the repairs of 1898 have been made with a less proportion of skimming than theretofore.

As before stated to you, the dimensions of each repair are measured, its location established by distances along and from the curb, and then platted—for the double purpose of obtaining the areas, and having a record of the repairs under guarantee. Under the annual contract system as above outlined, this complicated method is necessary to fix responsibility, yet it has many advantages in furnishing data for studying the various kinds of repairs.

The question of establishing a city plant with which to repair its asphalt pavements has been discussed, and estimates made—but as yet no further steps have been taken.

Appended hereto are two proof sheets from the City Engineer's report for 1897:

TABLE No. 1.

REPAIRS OF ASPHALT PAVEMENTS, BUFFALO, N. Y., 1885 TO 1897 INCLUSIVE.

	Year laid	1878	1879	1880	1881	1882	1883	1884	1885	1886	1887	1888	1889	1890	1891
	No. of streets paved	1	1	1	1	2	8	8	15	28	14	18	40	51	43
	Total square yards laid per year	9,286	7,264	8,755	8,876	25,501	35 815	79,774	113,498	236.001	126,490	201,668	249,838	370,125	419,579
	Guarantee	5 years.	5 years.	5 years.	5 years.	5 years.	5 years.	8 years.	5 years.	5 years.	5 years.	5 years.	5 years.	5 years	5 years.
Age after Guarantee.															
1	No. streets repaired			1	1			5	10	7	4	8	8	20	10
	Square yards on			8,019	8.876			50.544	98 654	104.791	55.988	110.504	101,552	178,109	174,046
	Total cost			$91 50	$6 00			$1,355 40	$2,003 56	$7,507 33	$1,588 85	$2,118 44	$4,823 72	$4.760 82	$4,287 18
	Cost per yard			.03	.0006			.027	.0214	.071	.027	.019	.0425	.0266	.0246
2	No. streets repaired	1		1			1	8	9	18	10	8	22	26	
	Square yards on	9,286		8,019			23,510	79,744	64 049	188 577	101.699	122,883	167.434	269 878	
	Total cost	$15 00		$60 00			$200 00	$8,710 72	$11,891 28	$20,875 57	$4,166 61	$10,228 59	$5,151 79	$11,248 76	
	Cost per yard	.0016		.02			.0085	.047	.185	.111	.041	.0836	.0307	.0418	
	Resurfaced W. Ave.								32,100 yds						
3	No. streets repaired		1	1		1	1	8	8	28	18	10	28		
	Square yards on		7.264	8,019		22,536	23 510	79,744	60.154	191,881	115,622	129 213	190,975		
	Total cost		$70 00	$12 67		$599 75	$1 217 73	$6,051 89	$3,877 14	$22,800 74	$8,538 86	$7,064 22	$7,297 87		
	Cost per yard		.01	.001		.026	.051	.0759	.061	.114	.0739	.0546	.0382		
4	No. streets repaired		1		1	1	2	8	11	21	18	14			
	Square yards on		7 264		8,876	22 536	34,833	79 744	66,617	189.092	110,496	178,261			
	Total cost		$196 23		$97 46	$171 85	$13,000 51	$3.340 43	$7,236 55	$22,956 04	$10,077 57	$12,142 25			
	Cost per yard		.027		.011	.008	.373	.0419	.109	Dr. tile,1214	.0912	.0701			
5	No. streets repaired			1	1	1	2	8	12	24	14				
	Square yards on			3 019	8,876	22 536	34.833	79,744	76,327	197,774	117,473				
	Total cost			$100 69	$141 72	$2,920 21	$967 15	$5,587 25	$12,482 18	$18,014 57	$7,675 79				
	Cost per yard			.034	.016	.129	.028	.0700	Dr. tile 1636	.0911	.0653				
6	No. streets repaired		1	1	1	1	2		11	25					
	Square yards on		7,264	8,019	8,876	22,536	12,305		74 686	200,481					
	Total cost		$600 00	$205 20	$1,240 60	$1,128 98	$288 85		$9.62[illegible] 95	$20,198 96					
	Cost per yard		.082	.067	.139	.05	.019		.1289	.1007					
7	No. Streets repaired	1	1	1	1	2	2		12						
	Square yards on	9,286	7,264	3,019	8,876	25,501	34,883		76,327						
	Total cost	$500 00	$115 16	$161 15	$55 67	$322 40	$3,923 35		$10 829 36						
	Cost per yard	.054	.016	.053	.006	.012	.1126		.1418						

8	No. streets repaired		1	1	1	2	2									
	Square yards on		7,264	8 019	8,876	25 501	24,492									
	To'al cost		$702 16	$36 88	$84 30	$608 17	$1,711 00									
	Cost per yard		.096	.012	.0095	.0238	.0698									
9	No. streets repaired	Resurface'	1		1	2	2									
	Square yards on		7.264		8,876	25,501	24,492									
	Total cost		$245 20		$75 86	$611 87	$1,005 87									
	Cost per yard		.033		.0084	.0239	.0412									
10	No. streets repaired		1	1	1	2										
	Square yards on		7,264	8 019	8,876	25,501										
	Total cost		$560.89	$74 28	$29 96	$529.92										
	Cost per yard		.077	.0246	.0034	.0207										
11	No. streets repaired		1	1	1											
	Square yards on		7.264	8,019	8,876											
	Total cost		$338 18	$143 00	$222 20											
	Cost per yard		.0465	.0478	.0250											
12	No. streets repaired		1	1												
	Square yards on		7.264	8,019												
	Total cost		$274 43	$131 14												
	Cost per yard		.0377	.0434												
13	No. streets repaired		1													
	Square yards on		7,264													
	Total cost		$773 52													
	Cost per yard		.1065													
Total cost repairs		$515 00	$3,875 77	$1 016 01	$1,953 27	$6,888 15	$22,264 46	$20 045 69	$57.947 97	$111,853 21	$31,997 68	$31,553 50	$16 778 38	$16,009 08	$4.287 18	
Yards maintained		9 286	7 261	8,019	8,876	25 501	35,815	79,744	110,418	203,871	122 780	201,665	244,087	341,875	323,743	
Cost per square yard maintained		.0550	.5336	.3365	.2201	.2195	0216	.2514	.5248	.5497	.2606	.1565	.0687	.0468	.01324	
Cost per square yard per year		.006	.0415	.0280	.0200	.0219	.0691	.0502	.0749	.0916	.0521	.0891	.0229	.0234	.0132	
Number years maintained		9	13	12	11	10	9	5	7	6	5	4	3	2	1	

Yards given are of asphalt only, and on streets repaired are only what were under City maintenance at the specified time.

Table No. 1 covers repairs from 1885—the first year any were made at city's expense, to 1897 inclusive; the number of streets repaired, their yardage, the total, and average, cost of repairs—are arranged under heading of year in which they were laid, and given for each year after expiration of contractor's guarantee. All guarantees, one year excepted, were for five years, which, by the way, has been increased to ten years.

One street has been paved 18 years and maintained by the city 13 years, at an annual cost per yard of .041; another, maintained 12 years at .028 per yard; a third, for 11 years, at .02 per yard. These three are residence streets, and were paved in 1879, '80 and '81, respectively, by and under direction of Mr. N. B. Abbott, of Columbus, Ohio, who also laid the first experimental piece of asphalt in Buffalo. Believing that the good result of these early pavements was due to the surface mixture which was clearly different from the later streets, I wrote Mr. Abbott, and received the following reply:

"A surface coating of Trinidad asphalt, Paraffine stillwax (known then as wax tailings), and ground limestone; the proportions were about the same as now used. The main difference was in my use of 'wax tailings,' where they use petroleum. I used on Franklin street a ground limestone much coarser than is now used—probably there were pieces ½ inch in diameter and from that down to fine dust.

"On Cottage and Bryant streets, I used much finer limestone, but not so very fine as is now used."

These streets are the ones referred to above, and in same order—and special mention is made of them on account of the low cost of repairs, though they are the oldest. On Franklin street, the coarse particles in surface have long characterized this pavement, and to my mind constitute a great feature in the wearing qualities, and should be taken as a pattern.

In the 1896 paper, I stated that this street would have to be resurfaced within two years or so, but it has not, though the repairs of 1897 amounted to $ .10 per yard, and while its surface is more or less wavy, may serve some time before repairs will cease.

Bryant street, paved in 1881, has been maintained at an expense of $.02 per annum, notwithstanding the fact, that of the total during a maintenance period of 11 years, two-thirds were expended in a single year, and that the sixth of that period, or the 11th of its existence. It is in fair condition to-day, though it has at long intervals a few cracks from curb to curb, which, however, show no signs of disintegration.

Table No. 2 gives the summary of yards laid, with guarantee, etc. The difference in any one year between columns 7 and 5, represents the yardage on streets not repaired that year, while the difference between

TABLE NO. 2.

SQUARE YARDS ASPHALT LAID AND REPAIRED AND COST OF REPAIRS TO JANUARY 1, 1898.

1 Year Repaired	2 Total Laid, Square Yards to Date	3 Total Under Guarantee, Square Yards	4 Total Maintained by Railroad, Square Yards	5 Total Maintained by City, Square Yards	6 Cost Per Yard Maintained	7 Total on Streets Repaired During Year Square Yards	8 Cost Per Yard on Streets Repaired	9 Actually Repaired, Square Yards	10 Cost Per Yard Actually Repaired	11 Cost of Repairs	12 Total Square Yards on Streets Repaired to Date
1885	283,739	267,189	....	16,550	.0060	12,305	.0080	100	....	$106 50	12,305
1886	....	....	....	19,569	....	....	....	....	....	....	....
1887	646,230	617,049	736	28,445	.0030	19,159	.0070	100	....	136 00	28,445
1888	847,331	792,649	736	53,946	0040	10,283	.0020	150	....	208 90	28,445
1889	1,097,231	1,006,734	736	89,761	....	....	....	....	....	....	28,445
1890	1,467,356	1,376,859	736	89,761	.0240	83,865	.0250	1,400	....	2,144 33	83,865
1891	1,894,348	1,690,353	3,816	200,179	.0190	158,859	.0240	2,600	....	3,855 22	168,145
1892	2,271,595	1,831,599	36,446	403,550	0920	245,368	.1520	27,883	....	37,423 21	298,477
1893	2,770,661	2,133,717	40,156	596,788	.0490	426,786	.0690	18,473	....	29,575 34	487,204
1894	3,319,113	2,480,501	40,156	798,456	.0510	604,391	.0680	26,553	....	41,239 50	666,145
1895	3,581,238	2,493,293	45,402	1,042,543	.0670	796,313	.0870	57,068	....	69,661 49	824,829
1896	3,663,402	2,205,332	73,652	1,384,418	.0439	1,039,658	.0580	62,768	....	60,852 53	1,107,566
1897	3,798,358	1,913,296	102,550	1,782,512	.0480	1,383,437	.0593	78,554	....	82,153 76	1,442,271
Total				6,506,478	.0503	4,780,424	.0685	275,649	$1 19	$327,356 78	

Column "Yards Maintained by City" does not include the yardage of streets, the guarantee of which expires in the respective years.

columns 12 and 5 represents yardage on streets which never had been repaired to any particular year inclusive. In each case repairs by the city are referred to.

Table No, 3 is one I have compiled for the purpose of comparing the cost of repairs on business and residence streets; each class again classified as with and without street railroad tracks. In making such classifications exactness is impossible, as many streets belong partly to one class, and partly to another.

TABLE No. 3.

Average cost per square yard for asphalt repairs on the various classes of streets, based on the yardage actually maintained after expiration of guarantee—1885 to 1897, inclusive.

	WITHOUT STREET CAR TRACKS.				WITH STREET CAR TRACKS.			
	Business Streets		Residence Streets		Business Streets		Residence Streets	
Years after Expiration of Guarantee	Cost per Yard	Number of Streets	Cost per Yard	Number of Streets	Cost per Yard	Number of Streets	Cost per Yard	Number of Streets
1	.032	12	.013	34	.051	20	.04	6
2	.124	16	.029	57	.118	21	.055	8
3	.067	12	.045	50	.114	15	.043	8
4	.117	9	.075	43	.157	11	.048	7
5	.138	7	.062	39	.167	8	.119	9
6	.131	5	.049	26	.172	6	.063	5
7	.18	2	.072	13	.259	1	.066	3
8	......	....	.047	6	......	....	.012	1
9	.....	....	.029	6	......	....	....	......
10	......	....	.027	4	......	......	.025	1
11	....	......	.034	2	.....	....	.047	1
12	......	....	.037	1	......	....	.043	1
13	......	....	.106	1	......	......	.....	....

The first compilation of this table was sent to the society at its Washington meeting, since which time I have taken opportunity to go over it more thoroughly with result here given. As presented, it was based upon the mere averages of average cost, whereas in its present form the results are quotients of total amount expended, divided by the total yards of streets repaired, during the respective maintenance periods of from one to thirteen years.

Summarizing the annual cost per square yard, the average of grand total would be:

	Business Sts.	Residence Sts.
With tracks....................................	.148	.047
Without tracks	.112	.048

In the above, the cost for repairs on residence streets is practically the same under both classes, and in the table in some years residence streets with tracks show less cost than those without, which is due possibly to the fact that on the latter the area maintained by the Railroad Company may not have been deducted, and to the further fact that part of such streets may not have had tracks, while the whole area tends to reduce the average cost, there being no means at hand to separate them. That the repairs on residence streets are less after the seventh year, is partly explained, in my opinion, by the fact that many defects, due to causes other than traffic, are remedied in the earlier stages. On business streets increased cost appears with each succeeding year.

The repairs are made in the city at expense of the General Fund, when the surface needing repairs does not exceed one-third of that on the street, which has been liberally construed as one-third of the area embraced by the original contract. When this one-third is exceeded, the work becomes repaving, and is done at expense of abutting property.

The Maintenance guarantee now in force provides: "Wherever any section disintegrates or shows waves in the surface, the asphalt and binder shall be cut out and repaired with new.

"All settlements of the surface showing a variation of 3/8 inch or more from edge of a four-foot straight edge must be brought to grade.

"Slight settlements over trenches may, if the Chief Engineer permits, be repaired by removing the surface by the heating process and laying new asphalt as specified above.

"If it is found necessary in any three hundred lineal feet of pavement to repair more than one-third of its area, exclusive of the pavement between the rails of the street railroad, or if the lineal feet of cracks for any section of pavements exceeds the proportion of one lineal foot to four square feet of pavement, then shall the entire wearing coat of such defective section be cut out to the concrete and new asphalt and binder laid as specified above. All cracks three-eights (3/8) inch or more in width shall be considered disintegration.

"If in the last year of maintenance it is found that more than one-half the total area under this contract has been repaired (excepting cuts made for underground work), then shall the contractor cut out to the concrete and lay new asphalt and binder."

THE PRESIDENT: The next paper is on "Street Curbing," by Mr. Horace Andrews, City Engineer of Albany, N. Y.

THE PROPER CURBING OF STREETS.

BY HORACE ANDREWS, CITY ENGINEER, ALBANY, N. Y.

The methods of improving city streets have attained such a degree of development that further progress towards perfection must be necessarily slow and can best be assured by a careful examination of each item entering into street construction.

We can realize the present excellence of modern streets by looking backward to the times, not so very remote, when the condition of the streets in London was far worse than anything we would now tolerate. At the close of the reign of Charles the Second, about 1685, when London was a city of about 500,000 inhabitants, its streets were in a state thus graphically described by a distinguished historian:

"The pavement was detestable. * * The drainage was so bad that in rainy weather the gutters soon became torrents. * * * This flood was profusely thrown to right and left by coaches and carts. To keep as far from the carriage road as possible was therefore the wish of every pedestrian. The mild and timid gave the wall; the bold and athletic took it."

The conditions depicted are sufficiently appalling, and we might anticipate that the rapid advance of civilization would soon lead to radical reform. However, at a date eighty years later so little progress had been made that we find the state of London streets described as follows: "Foot passengers are protected by rows of posts at intervals of four or five feet. Flat paving stones are not in general use and those that have been laid down are small and insecure. * * The only pavement, both for the road and the footway, consisted of large round pebbles, over which the rolling of the vehicles made the most dreadful noise. In the year 1762, however, an improvement was introduced in Westminster, followed by the city of London in 1766. The roads were paved with squares of Scotch granite laid in gravel; the posts were removed; a curb was laid down; gutters provided and the footway paved with flat stones."

Here we see the beginnings of our present raised sidewalks and can realize the painful inconvenience, endured for so many years, on account of their absence.

To retain the sidewalk at its proper elevation and to help form the gutter, the curbstone was used. It is the purpose of the writer to call attention to this detail of street construction, to which, frequently, little thought seems to be devoted.

The functions of a curbstone are such that great stability should be ensured, yet we often perceive that both permanence and strength are disregarded. Frequently specifications for pavement of the roadway call for excellent and expensive work while the curbstone is either left to be furnished without extra cost, as an incidental, or a stone of most insufficient size is specified. A recent specification for sheet asphalt pavement in the streets of one of our large cities calls for a curbstone three inches thick, in lengths of four feet or over and of such depth as to extend four inches below the surface of the pavement at the gutter, no special foundation being mentioned.

Let us consider the disturbing forces that tend to displace the curb and destroy its alinement. The pressure of the earth behind the curb, frequently augmented by heavy surcharges from piles of merchandise on the sidewalk, tends to overturn it. This pressure also tends to break the curb transversely or to cause it to slide bodily on its base. In our Northern cities the most severe disturbing action is due to the freezing of the ground beneath the sidewalk. The pressure from the expansion of freezing earth behind the curb is most apt to occur where the sidewalk is partly sodded and the ground is accordingly moist. Successive freezings of the earth behind the curb will occasion a succession of thrusts forward till the curbstone, when of faulty design, is sometimes inclined 60° or more from the vertical.

The ground below the curb is also upheaved by frost at places where the subsoil can become saturated through percolations from the sidewalks or permeable pavements on the roadway. The displacement from beneath tends to alter the height of the curb and to impair its appearance seriously. It is of importance that the height of the curb should be permanently maintained, as it serves for the regulation of the cross section of the roadway and sidewalks and for fixing the elevations of the houses. Where the sidewalks are sodded and especially where the curb is of small cross section and improperly supported, tile drainage may be of benefit; the writer has found it possible to secure stability without such drainage, even with sodded walks. Drainage may sometimes be a desirable safeguard, but great care should be exercised lest the soil should be so loosened in constructing the drain as to cause the curb to drop out of alignment. Posts and trees set too near the curbs tend to break and destroy the latter. Fires built in the gutters will deface, and will seriously damage granite curb. The constant blows from wheels in narrow business streets will slowly destroy even the most substantial stone. To withstand the destructive impact of wheels, curbs are faced with iron at certain places in the streets of London, and a concrete curb with a rounded edge of steel has been patented and used to some extent in this country.

The municipal engineer must seek a means of guarding against the destructive action of the various agents referred to and at the same time he should endeavor to avoid an expenditure so great as to be oppressive. Where stone can be readily procured the writer believes this to be the best material for the visible portion of the curbstone, and that the best kind of stone is granite of good quality. To render such curbing economical it should have a cross section of moderate size; to ensure its stability it should be reinforced with concrete. For aesthetic considerations the stone should be sufficiently well dressed to present a neat and uniform face and top surface. Granite has the advantage over most stone of looking well even if somewhat roughly faced.

The comparative cheapness of concrete should lead to its liberal use, and in case stone is difficult to procure the entire curb may be formed of concrete. Such curb will never convey as good an impression as when formed of natural stone, nor will it resist the wear of vehicles as well. Concrete curbing must be made with extreme care and with the best materials, but concrete used merely for adding to the stability of a curbstone need not be of better quality than that employed for the pavement foundation.

The curbstone should have a thickness at least equal to the depth of the gutter in order not only to be stable but to appear so. In many cities abroad curbstone of as great a thickness as twelve inches is employed and in Washington curbstones eight inches thick and eight inches deep are used. The occasional use of gutters of a depth of eight inches or greater, especially at receiving basins, might render a depth as small as eight inches insufficient. The writer is opposed to the use of a gutter stone. It is generally an unnecessary expense and the longitudinal joint between it and the pavement is much to be condemned. In narrow and heavily traveled streets every longitudinal joint having a length as great as one or two feet is sure to become a rut under the wheel traffic.

A concrete curb with gutter formed in one piece is admirably adapted to secure stability but is open to objection for the reasons stated. The end joints of curbstones should be so cut as to look well from the top and front. They should be substantially square but need not be cut precisely so for the entire thickness of the stone. In Liége, in Belgium, the curbstones, seven and one-half inches in width, are tongued and grooved at the ends, and a similar construction is seen in front of the Public Library in Boston. It is needless to say that such construction is merely an oddity and is an unnecessary expense. The Liége curbstone is an interesting example of the development of one detail of street construction with the neglect of others of greater importance; for in that city, the sidewalks, like the roadway, are paved with cubes of stone, four and a half inches on a side, concerning which a writer pathetically remarks: "One could wish himself shod in iron to escape the discomfort and pain caused by the inequality of these torturing cubes."

In setting the curbs it is well to keep the ends from actual contact; for this purpose strips of hoop iron can be temporarily inserted between the ends of the curbs as they are set.

Specimen curbs should be placed on exhibition and referred to in the specifications. The pattern curbs should be dressed in every respect in accordance with what the engineer desires and with due regard for what is practically attainable without excessive cost.

The foundation of the curb should be of concrete, having a depth of six inches. The depth of the curb should be such that the concrete under it will be nearly continuous with that under the street pavement.

The concrete placed behind the curb should have a thickness of six inches and should be brought to a level surface about three or four inches below the surface of the sidewalk. The layer of concrete under the pavement will then pass beneath and up behind the curbstone, affording an excellent support at a moderate cost; a cubic yard of concrete making foundation and backing for about thirty feet of curb. Concrete should have a slight excess of mortar and should be composed of hydraulic cement, sand and stone in small pieces. It will then be possible to consolidate it without disturbing the alinement of the curb. A mold should always be formed for the concrete. For that beneath the curb a piece of 6 by 6-inch timber, placed in front of the bed, answers very well and can be removed when the concrete is set. Boards, one inch thick, and left permanently in place can be used for shaping the back of the concrete. Where a street is to be repaved the old curb may often be used to advantage in place of boards, for backing the concrete.

The lengths of the individual pieces of stone should not be less than three and one-half feet. Contractors usually furnish stones considerably longer than this, as the labor of dressing joints is thereby reduced.

The appearance of street corners is much helped and vehicle traffic is facilitated by the use of circular curb of large radius. The writer for several years used a radius of 5.73 feet, which gave a length of curb of a tenth of a foot for each degree of center angle. This radius has more recently been increased to eight feet.

The numerous driveways crossing the sidewalks should have small circular corners. For these a radius of about two feet is a convenient one. Where streets are not laid out on a rectangular system the angles which the curb lines make with one another should be carefully measured in advance and in all cases the circular curb should be cut to the proper length to join the tangents neatly.

In the city of Albany, N. Y., an effort has been made for several years to improve the quality and to increase the stability of the curb.

The resulting appearance of the streets has been a source of satisfaction to the property holders as well as to the city engineer.

About forty-seven miles of curbstone have been laid with concrete foundation. None of this curb exceeds fifteen inches in depth, yet its alinement is much better than that of the former twenty-inch curb on sand foundation. The first granite curb was laid, on concrete, in 1889. It was five inches thick and twelve inches deep, costing $1.25 per foot. The subsoil was blue clay, yet the curb has kept its height and alinement very well. The thickness of the standard curb is now six inches, the depth remaining twelve inches. About 5 1-3 miles of the five-inch granite curb have been laid, while thirty miles of the 6 by 12-inch granite curb are now in place.

The granite curb as quarried costs about 22 cents per lineal foot delivered in Albany, coming by rail from Vermont and New Hampshire. Contractors have often laid it at prices too small to afford any profit, making up their loss on other items. Thus in 1897, 9.16 miles of 6 by 12-inch granite curb were laid at an average price of 39 cents per lineal foot for straight curb and 47.7 cents for circular. This year 7.62 miles of the standard curb have been laid at an average price of 52.5 cents per foot for straight and 76.4 cents for circular. The above prices include concrete and all incidental work.

Under the laws of the state of New York, all curbstones used by a municipality must be dressed within the limits of the state. Practically this requires all granite curb to be dressed within the city. The result in Albany has been a favorable one. The employment of citizens has met with popular approval. The opportunity of purchasing curb in its rough state is not confined to one or two quarries, whereas the number of quarries turning out dressed curb is very limited. The cost of the curb to the contractor has therefore been materially lessened since the passage of the law referred to.

In conclusion the writer would urge that substantial and handsome curbstone be used on all well paved streets. Without such curbing the best pavement looks somewhat inferior and may be compared to a poorly framed painting. Civic pride can only be aroused and municipal improvement can best be ensured by special attention to those details that appeal most directly to the eye, and a proper curbstone is not an insignificant detail.

Appended to this paper are the usual specifications for curbstone at Albany, N. Y.:

SPECIFICATIONS FOR CURBSTONES.

(1.) All the new curb furnished and set shall be of the best quality of granite curb. All curbstones must be equal in quality to and have their faces dressed as well as the specimen granite curbstones marked B. C. in the office of the City Engineer, the front of the curb when not self-faced and out of wind, to be pointed to a smooth face, the top to be axed to a plane surface. The stones to be in lengths of not less than three (3) feet six (6) inches, and to be six (6) inches in thickness, and of a depth of not less than twelve (12) inches and if they exceed this depth by more than two (2) inches, extra excavation will be required so that at least four (4) inches in depth of concrete shall be below the curb in every place. The face and upper edge are to be dressed to a line, and the top cut to a uniform bevel of one-quarter (¼) inch with the front. The front of the curb is to be smooth and to a fair line, without rounding and with no projection or depression exceeding one-quarter (¼) of an inch from the working line, and to be so dressed on the face from the top to the depth of nine (9) inches. The bottom to be roughed off, parallel to the top to the full thickness of the stone. The ends from top to nine (9) inches below top line shall be truly squared and dressed, so that when laid and abutted, the one against the other, joints shall not exceed one-eighth (⅛) of an inch in width, for the depth of nine (9) inches from the top. Strips of hoop iron shall be placed between the ends of the curb to keep them slightly apart. These strips are to be removed after the curbs are set. The curb shall be set truly to the line and grades given by the City Engineer. At least two inches in thickness of the curbstones, measuring from the front surface, shall be squarely dressed at the ends. The back of the curbstones must be dressed smooth and even to a depth of two (2) inches below the top of the same.

(2.) The corners of streets, driveways and alleys shall be provided with granite circular curb cut with a radius to be given by the City Engineer. The curb must be furnished in the number of pieces to each corner, that may be specified by the City Engineer, such curb to be of the same width and thickness as the curb in the other portions of the street, and to be dressed and set in like manner. The joints must be cut truly radial. The entire length of circular curb at each corner, measured on the outer surface of the curb, shall be exactly as the City Engineer may direct.

(3.) Concrete to be used as a foundation for the curbs shall be composed as follows, and mixed in the manner and with the proportions stated below: The contractor must provide a water-tight box or platform of sufficient size, and on this all concrete must be mixed. The contractor must provide two measuring boxes, one for the sand and one for the broken stone, these boxes to be of the dimensions given by the City Engineer and to be gauged and approved by him; the sand and broken stone for all concrete used shall be measured in these boxes or in such other way as may be approved by the City Engineer. In making the concrete a mortar is first to be made of one (1) barrel of freshly-burned Rosendale cement of the best quality, and equal to that used for the foundation of the pavement, eighty (80) pounds weight of such cement being taken as equal to one (1) cubic foot in volume, and one (1) box containing one and one-half (1½) barrels of clean, sharp sand; these ingredients shall be thoroughly mixed dry, and a moderate amount of water (about sixteen [16] gallons) shall afterwards be added to produce a paste of proper consistence. To the mortar, made as above specified, shall be added one box, containing three (3) barrels of clean broken stone, screened so as not to exceed one and one-half (1½) inches in greatest dimension, which shall be thoroughly freed from dirt and dust and be thoroughly wet before being added to the mortar. The whole mass shall be thoroughly turned over and mixed until every particle of stone is completely covered with mortar. The concrete material shall be turned over and mixed with shovels, by skilled workmen, upon the water-tight box or platform above mentioned, not less than four times before it is used. A piece of six by four or six by six-inch scantling shall be placed in front of the bed prepared for the concrete, which must be rapidly spread and thoroughly rammed in place with a heavy rammer till free mortar appears on the surface. After the ramming the scantling is to be removed. All mortar or concrete left in the boxes or platforms at the noon hour or at night, or whenever concrete laying shall have been stopped for one hour, must be immediately thrown out and must not be used as a foundation for the curbstone.

All curbstones are to be laid on a bed of hydraulic cement concrete, made as above specified, twelve (12) inches in width and six (6) inches in thickness; said concrete to be also laid back of the curbstone to a width of six (6) inches and to a depth of ten (10) inches. The amount of concrete used for the foundation and backing of the curb to be eleven-twelfths (11-12) of one (1) cubic foot for each lineal foot of curbstone. For a distance of five (5) feet on each side of each receiving basin top the concrete is to extend back of the curbstone to a width of one (1) foot, and to extend one (1) foot in depth below the bottom of the curbstone for the width of eighteen (18) inches. The concrete must be carefully filled into any open spaces in the end joints at the back of the curb. If necessary the joints must also be pointed in front with cement mortar. After the curb shall have been laid as herein specified and after the concrete backing shall have been tamped in place, Portland cement grout, mixed as specified for grouting brick pavement, shall be poured over the concrete backing until all the instertices and all open spaces at the ends of the curbstones, are thoroughly filled therewith. No sand or earth shall be placed on the concrete backing until it is grouted as herein specified.

(4.) Where the new pavement adjoins a private driveway crossing the sidewalk, a line of protection curb will be set on edge along the curb line with its top surface one (1) inch above the bottom of the gutter. The protection curb will be formed of sound pieces of the present curb or other equally good measuring not less than three (3) inches thick, and fifteen (15) inches wide, to be furnished and set by the contractor, without extra charge therefor. The protection curb may be omitted where the driveways are to be paved with brick or stone blocks and where the adjoining granite or brick street pavement at intersecting streets is in good condition and to the satisfaction of the Inspector. Similar protection curb must be furnished and set at all junctions between the contractor's brick pavement and cobble-stone pavement, or at unpaved streets and alleys; the top of such protection curb to be flush with the surface of the brick pavement.

(5.) The old curb now on the street is to be reset behind the new curb and at a distance from it sufficient to allow the six (6) inches of concrete to be packed in between the curbs. The top of the old curb, as reset, or of boards used in place thereof, is to be two (2) inches below the top of the new curb. The contractor is not to remove any of the old curb from the street. No price will be paid for resetting curb as here provided. Where there is no old curb or the old curb has been removed by the owners, a mold for the concrete must be formed of boards which must be left in place permanently. For all such boards left permanently in place the sum of eighteen dollars ($18) per thousand feet B. M. will be allowed the contractors.

(6) Wherever, on account of extra thickness of the curb, a six (6) inch space does not exist between the new and the old curb, as reset, the extra thickness of the new curb will be taken as an equivalent for the concrete replaced by it.

(7.) Curbstones must be relaid, where directed, at the prices bid by the contractor. The same kind of foundation, concrete or sand, must be used for the curb relaid, and in the same quantity, as that on which it was originally placed. Curbstones reset on curb lines with new concrete or sand foundation will be paid for in accordance with the contractor's bids for relaying curb. Curbstones reset, behind the new curb to form a mold, as heretofore provided, will not be paid for, the price for such resetting of curb being included in the contractor's bid for new curb.

THE PRESIDENT: The subject of the next paper is "A Street Extension Plan for the Entire District of Columbia," by William P. Richards, Assistant Engineer, Washington, D. C.

A STREET EXTENSION PLAN FOR THE ENTIRE DISTRICT OF COLUMBIA.

BY WILLIAM P. RICHARDS, ASSISTANT ENGINEER, WASHINGTOM, D. C.

A street system executed far in advance of its actual need is no novelty in the growth of modern cities. Philadelphia and New York at certain times have pushed their plans far into the future and the present admirable plan of New York between First street and the Harlem was considered, when finished in 1806, as sufficient for three centuries of city growth. Many of our Western cities have in like manner extended their boundaries and streets before individual enterprises have placed a barrier in front of such efforts.

On the other hand cities that have grown in a haphazard way have, at great expense, remodeled their plan or widened their streets either for artistic effect of commercial needs. The infusion of new life in Paris during the reign of Napoleon III. by radical changes in its ground plan is a well-known event. London has widened many of her thoroughfares for commercial purposes; Boston has spent millions to the same end, the great fire of 1872 affording opportunity to regulate some of the old highways in the heart of the city. New York, with her marvelous growth of recent years, has found it advisable to extend her street plan far beyond the Harlem River. The plan below Harlem that was deemed sufficient for three centuries was filled in less than one and we find to-day, north of the city, a great unsymmetrical system of highways too well improved to allow radical changes and resulting in a makeshift plan in the Twenty-third and Twenty-fourth wards.

In the light of such events and urged by its own experience, Washington has been impelled to extend its plan to the limits of the District. The total area covered by existing and proposed highways is sixty square miles. About fifteen square miles are included in the settled portions of the District, leaving forty-five square miles covered by a paper plan. The origin, development, characteristics and extent of the plan of Washington should be reviewed in order to appreciate the reasons for general and specific features of the extended plan.

An Act of Congress, passed on the 16th of July, 1790, established the permanent seat of government on the banks of the Potomac and authorized President Washington to appoint three Commissioners to have charge of the work connected with the founding of the Federal City. The bounds of the District were marked by Andrew Ellicott in the spring of 1791 and Major L'Enfant, a French engineer, was directed by Washington to prepare a plan for the future city. L'Enfant came to this country in 1777 and served with distinction in the Revolutionary War. He had written to Washington during the agitation in Congress over the selection of a permanent seat, asking for "a share in the undertaking," and adding that no nation, perhaps, had ever before the opportunity offered it of deliberately deciding on the spot where their capital city should be fixed, and although the means now within the power of the country are not such as to pursue the design to any great extent it will be obvious that the plan should be drawn on such a scale as to leave room for that aggrandizement and embellishment which the increase of the wealth of the nation will permit it to pursue at any period, however remote."

L'Enfant began his labors with unusual zeal and both Washington and Jefferson took a great interest in the work. Jefferson sent to L'Enfant his collection of maps of the principal European cities and expressed his opinion that none of them were comparable to the plan of old Babylon revived and exemplified in Philadelphia. L'Enfant accepted this idea for his street plan, but the avenues were essentially a triangular system used at that time in parts of France and applied more particularly to the treatment of great parks.

A map of the proposed city was finished in 1791 and laid by Washington before Congress, where its plan was greatly admired, but was criticised by some as being too extravagant, although Washington afterwards wrote of the plan as meeting with universal applause.

During the following year (1792) L'Enfant on account of constant friction with the Commissioners retired from the field, taking all his manuscript with him.

The authorities were, for a time, in a dilemma, but Andrew Ellicott, who had assisted L'Enfant in his work, was able to draw up a similar plan, which was completed and engraved in October, 1792, and which is the plan of to-day.

L'Enfant's map has since been recovered and engraved and the numerous notes and explanations upon it show the genius and enthusiasm of the man. He had the grandest conception of artistic development: He selected commanding points for great edifices and planned for statues, columns, obelisks, fountains, parks and public walks.

An outline of his plan is given on his map in three observations:

1. The position for the grand edifices and grand squares were determined on the most advantageous ground, commanding the most extensive prospects.

2. Lines and avenues of direct communication were devised to connect the separate and most distant objects with the principal and to preserve through the whole a reciprocity of sight.

3. North and south lines intersected by others running due east and west make the distribution of the city into streets, squares, etc.

Every grand avenue was made 160 feet wide; streets leading to the public buildings or markets were 130 feet wide; all others were 90 or 110 feet wide.

Some of the best artistic features conceived by this proud genius have never been developed, partly because they were located in marshes and low ground. This it seems was considered no obstacle and an intense faith in the city's future prompted the following bit of speculation, written on January 5, 1795, inscribed in a book in the Surveyor's office and designated as "Prophecy":

"The time will come when this wide waste of morass and thicket, open plain and wooded dell will resound with the busy hum of industry and be redolent with glow of action and the thrill of life—the swamps along the Tiber teeming as they do now with all the varieties of animal and vegetable life before the destructive march of man will gradually disappear and art will erect its palaces over the ruins of nature."

This prophet had the good sense to place no time limit for the grand transformation, for although it has been literally fulfilled, action was deferred for more than half a century. From Washington to Grant's term the city was a "straggling village," the wide streets causing the scattered houses to appear as in great fields and being named in derision "the city of magnificent distances."

Washington's new era dates from 1869, when Mayor S. J. Brown began to narrow the roadways and improve the parking. At length during Grant's presidency, the genius, iron will and commanding influence of Alexander R. Shepherd aroused the city to intense action, involving great expense and a marvelous change. Sewers were built, streets were put to proper grade and trees planted all over the city. It was the polishing and setting of a gem. About $25,000,000 was spent in three years but the change revealed the beauty and ingenuity of the city plan which Governor Shepherd admired so much.

The trees planted in their proper place along the curb intensified the vistas of capitol, public buildings and statuary as viewed down the well graded avenues. The triangles and small parks scattered over the city broke the continuity of parallel buildings in a pleasing manner and the circles standing in the center of main streets or avenues dispelled the monotony of straight lines and varied the lengths of vistas.

These improvements very soon engendered a rapid city growth. The boundary was approached, then passed by the overflow of population. Villas and subdivisions were well scattered over the District during the seventies and a bunch of them grew in fantastic shapes adjacent to the northern boundary of the city forming a marked contrast to the city plan. Each man had been allowed to locate streets over his land according to his own judgment and plat of the streets and lots was recorded in the office of the Surveyor as an instrument of reference for deeds and surveys. At this stage it became apparent that a city extension system should be mapped out for the entire District. In 1888 Congress declared that no more plans should be recorded unless made in conformity with the general plan of the City of Washington. This law was defective in not providing the way for the study and production of a general plan. It answered well near the city, but no one was wise enough to place his finger on any spot and say what the general plan should be.

This brings us to the inception of the present extension work.

In March, 1893, an act was passed by Congress "to provide a permanent system of highways in that part of the District of Columbia lying outside of cities." It provided "that said system shall be made as nearly in conformity with the street plan of the City of Washington as the Commissioners may deem advisable and practicable."

The act created a commission composed of the Secretary of War, the Secretary of the Interior and the Chief of Engineers of the United States Army, with authority for alteration or approval. Their final approval and the record of the plan in the office of the Surveyor made it a fixed guide for future subdivisions.

The first study of a system under this act was coincident with the completion of a topographical map of the District made with a plane-table by the U. S. Coast and Geodetic Survey. It was printed on sheets to a scale of 400 feet to the inch with contour intervals of five feet, each sheet covering one square mile. At first they were printed in four colors—streams in blue, contours in yellow, trees in green and property lines in black, but a reprint was made in black leaving off the trees. They were complete, accurate and very acceptable with one exception—the scale was unfortunate. Two hundred feet to the inch or better one hundred, is necessary for office work in grade studies. To one not acquainted with Washington's environs a little attention to this map will reveal a section of remarkable topography. The city proper lies on a rolling ground of from ten to one hundred feet above mean tide and is surrounded by ridges and plateaus three or four hundred feet above tide, which have been eroded by numerous streams into hollows and deep, narrow valleys. Here was presented a problem in topographical conditions quite different from the city where cuts and fills of forty feet were rare. A close checkerboard plan over the suburbs with maximum grades of eight per cent. would in places double any cuts and fills in the city while it covered a section five times as large and never so valuable. The promoters and friends of street extension who had urged its needs before Congress were wide in their views as to straight extensions and were given a fair hearing by the District authorities.

The board rules governing our final studies, which were generally acceptable, are:

1. That avenues should be extended with great directness to the District line, forming a fan shaped system of highways to the city. This gives the essentials of a spider web system.

2. That on account of its simplicity and checkerboard or gridiron system should be located wherever maximum grades of six per cent. shall not be frequent or cause cut and fills to exceed twenty feet.

3. That where direct extensions shall be of undulating grade curved highways are preferable, adding a picturesque feature to the system and relieving the monotony of straight lines.

4. That curves of small radii should be avoided and in very broken sections of narrow ridges or valleys it is preferred to follow the sides rather than the top or bottom of the hill.

5. That the largest number of avenues should lead to or from the city and cross avenues be infrequent and located on prominent ridges or on easy lines of communication.

6. That small parks and circles which are such features of the city plan be eliminated from the extended system and that large areas on prominent points of view be selected as parks and connected by avenues or curved drives.

It cannot be predicted in what way or to what extent the suburbs may be developed, but the view has been held that the system should not be so burdensome as to check suburban improvement, remembering, too, that the plan is for the future more than for the present and that a liberal policy should be expected in its development.

The field work made in aid of the studies was of a very simple character. A system of co-ordinate lines was extended over the District, permanently marked, and these connected with triangulation points of the Coast and Geodetic Survey, and with the various subdivisions, numbering about seventy, with an aggregate of one hundred miles of streets. All subdivisions and points of reference were plotted on the sheets by means of their geographical positions, most of the existing highways governing to some extent the actual locations of the proposed streets.

In the office work the sheets on a scale of one inch to four hundred feet were first used in drawing up a tentative plan followed by a detailed study on scales of one inch to two hundred feet and one inch to one hundred feet. Many of the large scale sheets were enlarged from the coast survey by photography and actual tests on the ground indicated satisfactory results with these enlargements.

The manner of conducting work in the office was for the assistants to submit independent studies, the best features contributing to a combined plan which was still further modified after public hearing before the District Commissioners and the Highway Commission.

To facilitate the work, as well as to comply with certain requirements of the law, the District was divided into four sections varying somewhat in topographical features and differing so greatly in value of land or their relation to the city, as to cause each section to be treated in an independent way.

Section one lies north of the city, is divided from Section two by Soldiers' Home and North Capitol street extended and from Section three by Rock Creek Park. It is generally of a rolling nature, resembling the city in topography, is elevated from one hundred to three hundred feet above tide and covers an area of 5,250 acres. A close copy has been made of the city plan, the streets taking 30% of the area; no grades need exceed 5% with proper developments.

Section two lies northeast of the city with elevation of from ten to three hundred feet characterized by wide valleys and broken ridges that have been eroded into circular hills or knolls. A rectangular plan has been devised that is rather unsymmetrical because of the artificial conditions arising from the railroad lines and old subdivisions. The section covers 5,570 acres with 33% in streets, maximum grades of 8% and maximum cuts and fills of twenty feet. A circular drive has been devised to connect the highest points which may be used for park purposes.

Section three lies west of Rock Creek Park, comprises 7,114 acres of exceedingly broken country from one hundred to four hundred feet above the Potomac. About one-half of this section has been covered with a checker-board plan and the rest with a combination of curves and tangents approximately parallel to the ridges and valleys. Blocks three hundred feet wide and two thousand feet long are frequent in the rough localities, although blocks of 250 feet by 600 feet are considered an ideal size. Grades of 8% with cuts and fills of fifty feet are frequent.

Section four comprises about 10,000 acres of land southeast of the Anacostia river with elevations of ten to three hundred feet. The section is so rough throughout that a curvilinear plan with varying sizes of blocks has been devised. The grades in this section will not exceed ten per cent.

In preparing the maps for final approval, block distances, widths of streets and their relations to the co-ordinate lines have been given. The establishment of grades or the marking of corners on the ground, as done in other cities, has not been followed here. This is left to the time when subdivisions shall be recorded, when the established grade will be guided by the tentative as near as good practice will allow.

After the outlines of so great a plan the question naturally arises when will its development be complete, or will a population ever cover it. I will not offer any phophecy but we can find some indications of what we may expect.

Curves of city population vary so much as to be very poor indications of what we may expect in the far future. The curve of a country population is a better guide. It is found that Washington curve of population agrees very closely with that of the United States, and it seems reasonable to assume that they will continue together, and that in fifty years we shall have more than half a million, and close to a million at the end of the next century.

To-day one-fourth of a million occupy fifteen square miles and we may roughly conclude that the whole District in another century will be fairly well settled. The embellishment of its plan, of course, may be extended without end.

THE PRESIDENT: The next paper is by Mr. A. W. Dow, Inspector of Asphalt and Cements, Washington, D. C., and is entitled "Some Points on the Theory and Practice of Asphalt Mixtures."

SOME POINTS ON THE THEORY AND PRACTICE OF ASPHALT MIXTURES.

BY A. W. DOW, INSPECTOR OF ASPHALTS AND CEMENTS, WASHINGTON, D. C.

The testing or examination of asphalts for paving has been carried on in a more or less intelligent manner from the time of the laying of the first pavement with this material, and although our knowledge, which has been gained by slow stages is yet very limited, still what we now have is such as to give us confidence in our predictions. I have no doubt but that there are some here who are calling to mind cases where an asphalt has been pronounced suitable for paving and the pavement has proved an utter failure, and other cases where one asphalt has been pronounced superior to another and the pavement constructed with the inferior material has proved the better. Failures and paradoxes are the great educators in all industries; the one gives us something that must be overcome, while the other gives us something to reason on. The asphalt paving industry is no exception to this rule, and I would not be far from right if I said it possessed to those who have not made a careful study of the subject, more paradoxes than any other industry; and how often are they wrongly interpreted or put aside as being inexplainable, with the saying that there is too little known about the subject, Judging from the poor selection of materials and the slipshod methods employed in the manufacture and laying of pavements, it is very evident that the subject is not well understood in many cases. But there are failures traceable to carelessness and willful disregard of known characteristics of the materials used.

It is hard to understand why these should be made unless it be that men become so convinced by their own arguments as to the remarkable good quality of their particular asphalt that they come to believe that no matter how they abuse it its good qualities will carry it through. I do not propose here to explain the cause of any particular failure, or to tell you directly how to avoid failures; but merely to present in as practical a way as possible the influence the selection of different ingredients has on the character of the pavements in which they are used, and discuss the theory of the cementing properties of asphalts. In this way the cause of some failures will be made self-evident, and why poor pavements are often made with good asphalts. I do not think that I am wrong when I say that many engineers do not explain the theory of phenomena met with in asphalt construction. This is because they do not apply the proper physical laws in their reasoning. And is this surprising when we consider that the cementing and other materials in general use in engineering work are solids, and involve the laws governing the cohesion and adhesion of solids for each other, while in the case of asphalt construction we have entirely different principles involved—those governing the attraction and adhesion of liquids for solids, for asphalt paving cements are in every sense of the word liquids. This may be novel to some present, but an examination into their physical properties will demonstrate the correctness of the assertion: Asphalt cements flow at all temperatures, the flow being quite marked at 75° F., and as the temperature is raised or lowered the flow becomes more rapid or sluggish, this change taking place to a different degree in different asphalt cements.

There are many every day illustrations of the flow of these thick liquids, the commonest being the oozing through the smallest cracks in the barrels or boxes containing them. I have here some illustrations of this flow at three different temperatures—26, 75, and 140° F.

Possibly you wonder why I have taken such a high temperature as 140°, but it is because I have found asphalt pavements to reach that high temperature on a hot day, and in the manufacture of a pavement the maximum as well as the minimum temperature to which it is subject should be considered in the examination of its ingredients.

The cement I have taken to illustrate the flow at the temperatures mentioned is one of our regular paving cements such as is used in the wearing surface of an asphalt pavement. This first exhibit illustrates the flow of this cement in one week, having been kept at a temperature of 26° F. A two-inch cube with a perfectly smooth flat face was placed on this board directly over the hole. Its flow into this hole, although not considerable, is sufficient to show that the cement is liquid at this temperature. This illustrates the flow of a similar cube placed in like manner on this board and kept at a temperature averaging 75°. Here is a third cube similar to the others and treated in like manner, except that it was kept at 140° for one hour. At this temperature the flow was visible.

I have also found that these thick liquids belong to the class of fluids that will rise in a capillary tube, thus showing their strong attraction for solid bodies. I believe that the laws of capillarity are the principal ones involved in the cementing in asphalt paving mixtures; and when applied will explain phenomena heretofore considered inexplicable. From the foregoing it is evident that asphalt cements may be looked upon as liquids, but there is another property possessed by them which must be considered, that does not belong to liquids as we commonly speak of them, and that is, they become brittle at certain temperatures. Asphalt cements, as I have before mentioned, become more sluggish or hard as their temperature is lowered, and at a certain hardness show evidence of brittleness, this brittleness increasing as their temperature lowers. It may be well to explain here that we can increase or diminish the softness of an asphalt cement at our will by the addition of a flux or harder asphalt, thus we are able to obtain any degree of consistency. As asphalt cements become brittle at a certain hardness and this increases as they harden, it is most desirable to have the cement as soft as possible, thus having the temperature at which it becomes brittle at the minimum degree. The problem now to deal with is the selecton of the sand: what sand which can be practically handled can be used with the softest possible asphalt cement and yet make a desirable pavement, that is, one that will not shove or mark too much under the traffic of the particular street on which it is to be laid on the hottest day; such a mixture will be best able to resist the cold. Of what character must the sand be to fulfill this requirement? From what has been said it is evident that asphalt mixtures are sand grains of various sizes, held together by the forces of attraction and adhesion of a liquid that we call asphalt cement. The idea of a liquid binding sand grains together is not as novel as one might imagine on first thought, and a very common example of this phenomena is exhibited by a sand beach which the tide has just left; we find here that the sand grains are held together so firmly by the limpid water that a wagon may be driven on it and scarcely leave a mark. That this hardness is due to the presence of water in the voids of the sand is evident, for when the sand dries it becomes loose and easily displaced. I had a good opportunity at one time to illustrate by a wet sand why I preferred that particular sand for paving. When first appointed to my present position I took occasion to make a radical change in the grade of sand to be used in the asphalt pavements. A gentleman connected with one of the paving companies and myself were watching the unloading of the first lot of the new sand. The sand was wet and cheesy, so to speak; that is, it could be cut out in big cakes; it did not look like a good mortar sand.

My companion remarked that that was not what he would call a good sand, and asked me if I was not afraid that I had made a mistake.

I called his attention to how much more strongly this sand, which was finer, was held together by water than the sand he had previously used, and explained that it would be held together proportionately stronger when asphalt cement occupied the voids. Practical experience has demonstrated the correctness of this choice of sand. That much can be learned from a sand when wet as to what value it will have for paving can be shown by comparing the two grades of sand just spoken of. On comparing these two sands when wet we find the finer packs remarkably hard, while the other packs but slightly.

Looking upon asphalt cements as liquids we would expect to find an analogous result when paving mixtures are made with these two sands, using with each the same asphalt cement: that the mixture made with the finer sand would be harder than that made with the coarser—this is what we find in practice—while using a much softer asphalt cement with the finer sand than with the coarser, equally hard mixtures are produced. The cause of this is explained by the fact that the voids in the finer sand are much the smaller in size, which means that the sand grains are closer together. It is a well-known fact that the smaller the space between two solid bodies that are held together by the attraction of a liquid between them, the greater the adhesion.

There are two grades of sand that have small voids, one that is composed of all very fine grains and the other is a sand with the grains so graded from coarse to fine that all the large voids are filled with smaller grains, and their voids in turn filled with still finer.

The latter is the most desirable sand for several reasons; among them are: it is more easily handled in the manufacture of the pavement, and it requires less asphalt cement; not alone because the per cent. void is less, but the total surface area of the sand grains is smaller.

I have also found that the shape of the grains has considerable influence on the hardness of the mixture. The more round and smooth the grains of a sand, with all other conditions being the same, the softer the asphalt pavement made therefrom. The great difference in pavements due to the use of different sands does not seem to be appreciated by many. It is not merely a theoretical difference to be put aside as too trivial to consider in practical work, for there is nothing that is responsible for more failures than the use of the wrong sand. The differences in pavements due to the character of the sand used can be well illustrated by some practical instances. The pavements laid in this city in the summer of 1894 mark as much and in some cases more, from traffic, than do those laid here last year, and some of the former crack in cold weather. On comparing the records of these pavements the asphalt cement in the former is found to be 20 degrees of penetration harder than that in the latter pavements, so that the difference must be due to the sand. An examination of the sands shows that they both have moderately sharp grains with the following mesh composition:

	1894 Pavement.	1897 Pavement.
Retained on 20 mesh per linear inch...	4.5	2.5
" 40 " " " ...	40.0	21.0
" 60 " " " ...	32.0	35.0
" 80 " " " ...	9.5	8.5
" 100 " " " ...	6.0	10.0
Passing 100 " " " ...	8.0	24.0

Another illustration of where a hard pavement contains a soft asphalt is in the well-known Neuchatel rock pavements that are used so extensively in Europe, and about which there is no question as to their wearing qualities. This pavement is a limestone powder cemented together by an asphalt so soft that its flow is perceptible at a temperature of 75° F., which is about three times softer than any asphalt cement used at present in our pavements.

My attention was first called to the importance of the shape and character of the sand grains a few years ago. I was required to make an examination of some paving materials for a Western city and found, that the asphalt cement was as hard as any we were using here, the sand was moderately fine, and judging from past experience I believed that a softer asphalt cement could be used with it. As the climate of this city was subject to greater atmospheric range and much lower temperatures than Washington, I wrote, advising the use of a softer asphalt cement. I was much surprised to hear in reply that they had commenced work on the paving and that the pavement already laid was so soft that it would not be advisable to make it still softer. An investigation was immediately started to discover the cause of this softness. Nothing was found wrong until I examined the sand with a glass, when the grains were found to be so smooth and round that they resembled polished glass balls. On further investigation in the laboratory it was proved conclusively that there was a decided difference in mixtures made with sand that was smooth and round and that which was angular. All else being the same the mixture made with the smooth sand was much softer than that made with angular sand. This hardness of paving mixtures made with angular sand is undoubtedly due to the keying into each other of the irregular sand grains. Too sharp a sand that is one that would be so jaggid as to be liable to have pieces easily broken off is not desirable nor for that matter is the use of any sand whose grains are liable to fracture.

As sand is 90 per cent. of the pavement, why should it not be the most important ingredient to consider, and when a pavement is at fault, why should it not be more responsible than the asphalt which now bears the brunt of all failures?

THE PRESIDENT: Our next paper is one on the relative values of paving materials, by Mr. George W. Tillson, Civil Engineer, of Brooklyn. He is not with us but has sent his paper to Mr. Lewis, who will read it.

Mr. Lewis read Mr. Tillson's paper as follows:

THE RELATIVE VALUES OF PAVING MATERIALS.

BY GEO. W. TILLSON, MEM. AM. SOC. C. E., BROOKLYN, N. Y.

The discussion of paving materials is nearly as old as pavements themselves. In the early times availability generally determined the kind to be used, but as our cities increased in size and importance, the question as to what was the best received, and is now receiving, a great deal of attention. It is not easily settled, because the best material for one section is not necessarily the best for another. However intelligently the question be considered, it will never be possible to arrive at a conclusion that will suit all cases. A perfect pavement, however, possesses certain qualities, and by a careful study of these it will be possible to assign them a value which will be permanent in all locations. By next taking up the different materials offered for paving purposes and examining them with reference to these already assigned values, a result can be reached that will give a fair average value of any material. These results can be tabulated, and by knowing all the conditions affecting any street a proper selection can be made by applying the table.

A perfect pavement should be cheap, durable, easily cleaned, present little resistance to traffic, not slippery, cheaply maintained, favorable to travel, and sanitary.

The question of first cost, is very important. As with individuals, so it is with corporations: what is most economical in the end must often be given up and an inferior article adopted, because the available funds will not permit the required outlay. If the best cannot be used, the one nearest to it must be taken, provided it comes within the appropriation. An advocate of a new paving material is almost invariably met with the question, What will it cost? If the price be extreme, he will have a hard task to introduce it, no matter how great his other attractions may be. Cheapness, then, has been given a value of 15 out of a total of 100.

Durability is probably the most important quality of any material. Ultimate cost depends as much upon this as upon first cost. No matter how cheaply a pavement may be laid, or how pleasing it may be, if it requires constant and frequent renewal its real value is greatly diminished. This is especially true in large cities, as the delay and inconvenience to business on a crowded street may often amount to more to abutting tenants in dollars and cents than the actual cost of the pavement. In a country, too, like America, where the tendency is to build and then allow repairs to take care of themselves, durability is most important. Its value has been fixed at 21.

The growing demand for clean streets in our cities has brought into prominence any pavement that can be easily cleaned. What this amounts to in money can be appreciated by a statement made in December, 1896, by Col. George E. Waring, Jr., at that time Street Cleaning Commissioner of New York City. At a meeting of the American Society of Civil Engineers he said that if all the streets of New York were paved with asphalt where the grades would permit, and the street car tracks constructed with grooved rails, the cost of sweeping the entire city would be reduced from $1,200,000 per annum to $700,000. That is, there would be a saving annually of $500,000, which, capitalized at 4%, would amount to $12,500,000 in a city that at that time had a pavement mileage of 431 miles, of which 94 were already paved with asphalt. Easily cleaned is assigned 15.

Resistance to traffic is an important item. In fact, one of the chief provinces of a pavement is to reduce this, and consequently a pavement that can bring this to a minimum is of particular value. A mechanical device that would reduce the friction of a machine 50 or even 25 per cent would be of incalculable benefit, yet a good pavement on a street accomplishes this. It makes one horse do the work formerly performed by two. Its assigned value is 15.

The slipperiness of a pavement depends primarily upon its material, but a great deal upon its condition. The former will be considered here. The efficiency of a draft horse must vary with his foothold. If it be good he will be able to use his entire strength to draw his load, while if he be in constant danger of slipping and falling he can accomplish very little. Very few statistics have been gathered on this point. One case can be given, however, when observations of traffic were being taken on several streets in the winter time. On the first day the hourly traffic was at the rate of 225 tons between 11 and 12 o'clock, reaching 270 tons between 3 and 4 o'clock. On the day following, the traffic between 11 and 12 o'clock was 305 tons. About 2 o'clock snow began to fall, making the pavement very slippery, reducing the travel to such an extent that it had fallen off to 40 tons between 3 and 4 o'clock. That is, it was comparatively deserted. All of the other streets upon which observations were being taken showed the same results. Not slippery has been valued at 7.

Maintenance is closely allied to first cost. Unless it be known and considered in the adoption of a material a choice cannot be made intelligently. What seems to be sound selection will often be ruled out by the cost of repairs. Any material will require constant attention, but that one which needs the least and permits that to be done with the least inconvenience to the public is of most value. Cheaply maintained has been given a rank of 10.

By favorable to travel is meant the ease and comfort that is enjoyed in driving over a smooth pavement, and the decrease in the wear and tear of vehicles and horses. No attempt ever has been made to measure this in actual money, but it is known to be great. It is a pleasure to drive over such pavements, and actual pain to drive upon others. As our streets are for enjoyment as well as use, this property must be considered. The large number of bicyclists constantly on our highways makes this especially important. Its value is placed at 5.

Another function of a pavement is to preserve health. In large cities it is impossible to prevent decaying matter from being deposited in our streets. If a pavement be of such a character that any of this collect in joints so that it is not removed by the street cleaners, it cannot but be very deleterious to the general health. Consequently a pavement that is impervious to water, has a smooth surface, and is not itself composed of organic matter, will be sanitary. Noise, too, must be considered. A noisy pavement prevents sleep, rasps on the nerves of the sick and prevents conversation on the street. This question of noise is of such importance that in Greater New York estimates have recently been made for repaving around all schoolhouses in the city with a smooth and comparatively noiseless material. Sanitation is ranked at 13.

Having thus briefly outlined the characteristics of a pavement and assigned them a value, it will now be in order to take up these characteristics with reference to the different materials, and apportion to each its amount according as it approaches perfection in each property.

The pavements to be considered are granite blocks, laid on six inches of concrete with tar and gravel joints, called Granite A; granite blocks laid on sand, with joints filled with the same, called Granite B; asphalt wearing surface two inches thick, binder one inch, on six inches of concrete; brick, also on a concrete foundation six inches thick, with joints filled with pitch or cement; Belgian trap blocks on sand; macadam eight inches thick, and cobblestone. Wood has not been taken because it is only being used now in some of our Western cities, and, as laid, can only be considered as a substitute for a pavement. It may be said that this is practically true of cobblestones. That may be so, but its use illustrates the scope of the table. This table, according to its present values, is available only in the vicinity of New York City. But the theory of it is correct, and modifications can be made so that it will apply to any section desired.

First cost varies, of course, in each locality, and each material will vary in its percentage as the price varies. Taking the average of the bids received in Brooklyn in 1897, we have:

Granite A	$2.50
Granite B	1.65
Asphalt	1.75
Brick	2.00
Belgian	1.40
Macadam	0.75
Cobblestone	0.40

all per square yard complete.

Assuming their value to be inversely as their cost, we get Granite A 2, Granite B 4, Asphalt 4, Brick 3, Belgian 5, Macadam 7, and Cobble 14.

It is somewhat difficult to assume any definite period as the life of a pavement. In some cases the amount of traffic determines it entirely. But when a pavement is laid of perishable material like asphalt or wood, while wear will hasten the end, it has a period of life beyond which it cannot go. Assuming the traffic then to be normal, the time the different materials should last with ordinary repairs is:

Granite A	25	years
Granite B	20	"
Asphalt	15	"
Belgian	20	"
Brick	15	"
Macadam	8	"
Cobblestone	18	"

Figuring as before we have for their percentages:

Granite A	21
Granite B	17
Asphalt	13
Brick	13
Belgian	17
Macadam	7
Cobble	15

Some figures already have been given as to the value of having a pavement that is easily cleaned. The street that uniformly presents a smooth and even surface can be cleaned at much less expense than one that is rough and uneven. Working on this principle Granite A gets 11, Granite B 8, Asphalt 15, Brick 12, Belgian 7, Macadam 5, and Cobble 2.

Many experiments have been made to determine the amount of force necessary to draw a load over different roadways. The results vary greatly, as the attendant conditions are so many that tests cannot be expected to agree except as to general results.

According to the best authorities the number of pounds required to move a load of one ton at a speed of three miles per hour, the grade being level, is

Granite A	36
Granite B	45
Asphalt	17
Belgian	38
Macadam	42
Cobblestone	75

Brick must be between Asphalt and Granite A.

This, then, will give a percentage to Granite A of 7, Granite B 5, Asphalt 15, Brick 11, Belgian 5, Macadam 5, and Cobble 3.

The relative slipperiness of the different materials often has been discussed. It varies greatly with its condition. For instance, asphalt is more slippery when it is dirty and wet, granite when it is clean and dry. Extended observations were taken in London by William Haywood, Engineer of the Commissioner of Sewers, in 1873, to determine the number of accidents occurring on different pavements. From his results he deduced that a horse would travel 132 miles on granite, 191 miles on asphalt and 330 miles on wood without having an accident of any kind. In 1885, Captain, now General, F. V. Greene had a series of observations made in ten of the principal cities of this country for the same purpose. From these he decided that in the United States a horse would travel on wood 272 miles, on granite 413 miles, and on asphalt 583 miles without an accident. In both of these cases the falls were divided into those upon the knees, the haunches and complete falls. Falls upon the knees on a rough pavement should not wholly be charged to slipperiness, as a great many must have been caused by stumbling. Captain Greene found that of a total of 84 falls, 68 were upon the knees. Assuming that one-half of the latter were stumbles only, the deduction would be that a horse would travel 698 miles on granite without an accident due to slipperiness. These results, of course, are general. From these and other observations, Granite A is given 6, Granite B 5, Asphalt 3, Brick 6, Belgian 4, Macadam 7 and Cobble 5.

The cost of maintenance of pavements varies greatly in different cities. It is governed principally by the character of the material, amount of traffic and the condition in which the streets are kept. What is good repair in one city would not be allowed in another. The records on this subject are very meager. Systems vary in all places, and not much attention is paid to the cost of any particular street. Granite well laid requires very little repairing. Asphalt has generally been repaired by contract after the expiration of a five years' guarantee. Some cities pay a price per yard for the entire street; some pay for the actual quantity of new pavement, and others for the amount of material used. Under ordinary traffic the repairs should not cost more than six cents per yard per annum. Brick has not been in use long enough to obtain reliable information upon its cost of maintenance. In this paper it has been assumed to be the same as asphalt. Belgian block requires but little repairing, as it is hard and well resists the action of travel. The cost of maintaining macadam is great and variable. The reports of the City of Glasgow, Scotland, show that the total cost of macadam repairs for the years ending May 31st, 1896 and 1897, was ten cents per yard. In London they sometimes reach sixty cents per yard, and in Paris forty-four cents. In Nashville, Tenn., the stone used is so soft that the streets often require resurfacing several times a year. Traffic tells very quickly on this kind of a pavement. The values allowed are Granite A 10, Granite B 7, Asphalt 6, Brick 6, Belgian 7, Macadam 3, Cobble 2.

Probably no figures can be found upon which to base a calculation for favorable to travel. Yet the paving to livery men, firms and corporations employing many teams must be great when poor pavements are replaced with good. Stone pavements are very severe upon both horses and vehicles, especially when they are a little out of repair. The allowances are made arbitrarily. Under this head Granite A has 3, Granite B 2, Asphalt 5, Brick 4, Belgian 2, Macadam 5 and Cobblestone 0.

There is a great difference in the sanitary value of the materials in question. Asphalt can be kept absolutely clean, is impervious to water, free from noise and has all the requirements of a sanitary pavement. Granite A and Brick have their joints well filled with permanent material, and have an even surface. Granite B and Belgian have joints loosely filled with sand, which is soon swept out more or less and replaced with street refuse of all kinds. Decaying as it does, it is offensive and detrimental. A cobblestone pavement never can be kept clean. To make it so would remove all the earth that maintains the stones in place. All stone pavements are very noisy, and so are illy fitted for streets near hospitals, schoolhouses, churches or similar buildings. There is no doubt but that the noise from stone pavements contributes largely towards all nervous disorders. Macadam is extremely dusty, absorbs moisture of all kinds, and is hardly to be considered for a city street, though it ranks high in some respects. In the old City of New York the number of deaths from all causes in 1892 was 44,329; 1893, 44,486; 1894, 41,175; 1895, 43,420; 1896, 41,622, and in 1897, 38,877, showing an absolute decrease in that period of 5,452, despite a large increase in population. This is a remarkable record. It is accounted for by increased sanitary measures in general and largely to the laying of asphalt pavements on the east side, where the population is larger per acre than in any city of the world. The streets have been kept clean, and they are in a measure the recreation grounds of the people. As a sanitary pavement, then, Granite A receives 9, Granite B 7, Asphalt 13, Brick 10, Belgian 5, Macadam 5, and Cobblestone 2.

The table can now be completed. By summing up the values under each head the true worth of each material is obtained, and by comparing these totals with each other, we arrive at their relative rank.

	Percentage.	Granite A.	Granite B.	Asphalt.	Brick.	Belgian.	Macadam.	Cobblestone.
Cheap	14	2	4	4	3	5	7	14
Durable	21	21	17	13	13	17	7	15
Easily Cleaned	15	11	8	15	12	7	5	2
Light Resistance to Traffic	15	7	5	15	11	5	5	3
Not Slippery	7	6	5	3	6	4	7	5
Cheaply Maintained	10	10	7	6	6	7	3	2
Favorable to Travel	5	3	2	5	4	2	5	0
Sanitary	13	9	7	13	10	5	5	2
	100	69	55	74	65	52	44	43

Having constructed the table, it will now be in order to illustrate its use. Assume, for instance, a street over which the traffic must be great and continuous. Ultimate cost is of great importance. It overrules first cost. Light resistance to traffic, and also foothold for horses, are ruling elements, so that any power may draw the maximum load. The items first to be studied, then, are: Durability, Maintenance, Traction, and the non-slippery property. Consulting the table and combining the values for these items, Granite A has 44, Granite B 34, Asphalt 37, Brick 36, Belgian 33, Macadam 22 and Cobble 25. Granite A has such a decided lead over the others that it would hardly be necessary to make a further examination before coming to a decision, but when the figures are as close as the next four, ranging from 37 to 33, a careful study of the remaining qualities would be required. In this particular instance Granite A stands so near the top on the totals and so far ahead in the special requisites it would seem that no mistake could be made in selecting it as the material to be used.

Consider next a residential street built up with homes whose owners have means sufficient to afford the best of anything they desire, and, while not wishing to be extravagant, they do want and expect to have the best pavement that can be laid without regard to expense.

This is a different proposition. First cost, durability and maintenance, of the utmost importance before, can be left out entirely. Easily cleaned, not slippery, favorable to travel, and sanitary, are the governing characteristics. Now Granite A has 29, Granite B 22, Asphalt 36, Brick 32, Belgian 18, Macadam 22 and Cobble 9. Asphalt, possessing all the desired properties in so high a degree, should be selected without question. It may be said that the durability and maintenance are too hastily disposed of, and that by considering them the results would be changed. But here is the point of the whole argument: The property owners can afford the best. They would not carpet their drawing rooms with hemp matting because it would last longer than tapestry, nor furnish their dining room table with crockery and pewter rather than with china and silver. The idea is the best material under required conditions. The above conclusions would generally hold good for the best retail business streets.

Now let us take a residence street with very light traffic, where the abutters wish a good but an economical pavement; one that will be durable and as near first-class as their pocketbooks will admit. This requires careful consideration. The destructive action of travel is almost eliminated; durability will be governed by the action of the elements. Every quality but light resistance to traffic must be taken into account. This gives Granite A 62, Granite B 50, Asphalt 59, Brick 54, Belgian 47, Macadam 39 and Cobble 40. Granite A leads, but it gets its supremacy from its great durability under traffic, a property that is not required here. Leaving this out there remains Granite A 41, Granite B 33, Asphalt 46, Brick 41, Belgian 30, Macadam 32 and Cobble 25. All but the three leading materials can now be eliminated, leaving for further consideration Granite A, Asphalt and Brick. Now, while durability has been left out, its value has been determined by the action of traffic and weather. In this case action of traffic is left out, and when it is considered that asphalt has a life that is determined by climatic conditions irrespective inspection of traffic, it will be seen that in such a case as this Granite A and Brick can consistently be placed above it. These two materials now stand at the same value, 41, but by examining the table it will be seen that Granite A gains 4 points over Brick on maintenance, simply on account of its superiority under heavy travel. Leaving that out of our total, Granite A has 31 and Brick 35, and this is plainly the proper material for the street.

If the property owners, however, think the price too high, and prefer granite with its inconveniences to the more pleasing brick, then Granite B would be the choice. But it must be understood that money casts the deciding vote.

Assume next that a country highway is to be improved where the traffic is not heavy, but the road is needed to facilitate the intercourse between towns, or to connect a suburban village with the parent city, Sanitation, Easily Cleaned, Durability (except as to action of weather), and Light Resistance to Traffic can be eliminated. Sanitation and Easily Cleaned, because on a sparsely settled road matters are unimportant that could not be allowed in a city; the other qualities, because no heavy loads will be attempted. There will remain, then, Granite A 21, Granite B 18, Asphalt 18, Brick 19, Belgian 18, Macadam 22, Cobble 21. Here the values are more nearly alike but the cost of the first five materials will rule them out, when there can be no question between macadam and cobble on account of the undesirability of the latter, even though the former has but one point in its favor. By modifying the foundation for brick under these conditions it would very likely make a good showing, and in many localities prove the proper material.

The above illustrates the workings of the table, and while there are many imperfections in it, as much of it has been settled arbitrarily by the author and allowance must be made for the personal equation, it does seem, to him, at least, that it is a step in the right direction. That it is getting away from glittering generalities and establishing plain figures for certain elements that have not been valued in exact terms before, so that they can be understood and of service to those wishing information. If this attempt brings forth discussion here at the present time, or later, in other circles, sufficient to place these figures at their true value, the author will feel fully repaid for the labor expended upon this attempt.

THE VICE President: The papers read are now open for discussion and I would ask members to be as concise and brief in their remarks as possible.

CAPTAIN BEACH: I was a little surprised to hear Mr. Lewis state in his report that in Brooklyn there was more trouble with the asphalt close to the rail on the inside of the rail, rather than on the outside. The reverse has been the case here. The asphalt between the rails wears much better than it does outside. In talking the matter over with Mr. Lewis he says that their streets are very seldom more than twelve feet between the rail and the curb. Here they are anywhere from fifteen to almost twenty-five in some cases, and I presume that a large part of the discrepancy is due to the fact that the asphalt close to the rails here in Washington does not receive the same travel that it does in other cities, and also that there is larger amount of expansion and contraction in a large sheet of asphalt, than a smaller piece of asphalt gets. That is about the only way I can account of that discrepancy. With regard to Mr. Guthrie's statement concerning the cost of repairs to asphalt pavements I would state that I have here just a rough copy showing the cost of repairs to asphalt pavements in Washington that have been laid in the past twenty years, showing the cost of repairs per square yard per year, for each year since the guaranty period of five years expired. The average throughout the entire City of Washington for the past twenty years is 3.2 cents per square yard per year. I will mention a couple of streets which gentlemen can examine for themselves.

A MEMBER: Is that sheet asphalt or block asphalt?

CAPTAIN BEACH: Sheet asphalt. I have here I street, between Thirteenth and Fifteenth. Those are the two blocks east of here. This pavement was laid in 1874 and beginning with the sixth year, when the guarantee period expired, the cost per year per square yard has been as follows: .5 of a cent; 1.5 cents; 1.2 cents; 1.1 cents; 3 cents; 5 cents; 1.2 cents; 6.2 cents; 1.5 cents; 6.3 cents; 2.4 cents; 1.5 cents; 7.1 cents; 4.1 cents; 3.1 cents.

THE VICE PRESIDENT: Was there any reason for that large cost in one year? Were there any unusual circumstances that year?

CAPTAIN BEACH: That I cannot say. There may have been. There may have been a large piece resurfaced, or something of that kind.

Now taking this piece immediately adjacent to the hotel, I street between Seventeenth and Eighteenth, the pavement was laid in 1880. The cost of repairs, beginning with the sixth year, was .0, .0, .2, .3, .3, .0, 6.2, .0, .0, 1.8, 2.3, and 2.1. I mention this so that every member can examine these pavements for himself.

There is one further point to which I should like to invite the attention of all the members while they are in this city. Everything that has been said so far has been with reference to sheet asphalt. I should like to invite attention to the asphalt block pavements as they exist in this city. We find most of them in the eastern section of the city, beyond the Capitol building, on what is called Capitol Hill. Those pavements have been down eleven or twelve years, some of them. They are being laid all the time, but the oldest were laid eleven or twelve years ago, and they have not received one cent's worth of repair in that time.

MR. HEWSON: What is the travel there? Is it mostly light travel?

CAPTAIN BEACH: Light travel. They are residence streets almost entirely. There are one or two of those streets that have rather heavy travel for Washington, which is light travel for other cities.

MR. HEWSON: What is the space between the rails and the curb, where there are tracks in the streets?

CAPTAIN BEACH: There is plenty of room for travel.

MR. HEWSON: In our streets that space is very much narrowed down.

CAPTAIN BEACH: There are some asphalt block pavements, however, upon streets which have considerable heavy travel, hauling of stones, &c., and they wear as well as the sheet asphalt. I will state that there were asphalt blocks laid many years ago which did not give good results. An example of that can be seen at the intersection of Seventh street and Pennsylvania avenue, where the pavement was partly resurfaced with sheet asphalt several years ago. The reason that a part there is now allowed to remain in its present condition is that the adjacent property owners cannot agree among themselves and with the office as to exactly what is to be done and consequently it is allowed to remain.

Mr. Lewis: Was not limestone used in those early block pavements?

Captain Beach: Yes, but the trouble as far as I can find out is largely due to the quality of the asphalt that was used in them perhaps as much as in the quality of the stone. They were laid before I came to Washington. The more recent block pavements are made of asphalt which is required to fulfill the same specifications that the asphalt for the sheet asphalt pavements is required to fill. Limestone was formerly used and gave fair results. The stone that is being used at present is, I believe, granite. The use of trap might give still better results. I should like to have members interested in asphalt pavements examine those asphalt block pavements before they leave the city. Block asphalt is not as slippery as sheet asphalt. It can be laid upon a steeper grade. It does not retain the moisture in sudden changes of weather and become slippery to the same extent as sheet asphalt does and it possesses many other advantages. For instance, in cities where there are no permanent asphalt plants, I should think the block asphalt pavement would possess great advantages, because skilled labor would not be required for the repair of such a pavement. The blocks could simply be purchased and laid by ordinary mechanics who could lay brick or granite blocks.

Mr. Hewson: What is the cost?

Captain Beach: The cost in Washington for the asphalt blocks this year is $1.77 per square yard, laid upon gravel. The cost for sheet asphalt upon a six-inch concrete base last year was about $1.58. This year it is $1.77.

Mr. Hewson: Are these block pavements laid on sand, on the same foundation?

Captain Beach: On a gravel foundation, ordinary bank gravel, just as it is dug out of the bank.

Mr. Eldridge: I should like to ask as to the relative heat of the asphalt blocks in the summer time compared with the sheet asphalt pavement. I have heard a great many complaints by laboring men of the heat of the sheet asphalt pavement, resulting in the ruination of the horses' hoofs. Do you know anything about the comparison of those two?

Member: How about heat in asphalt pavements?

Captain Beach: There were some experiments and tests made by Mr. Dow, our asphalt inspector, during the past summer. On a day when the temperature of the air a couple of feet above the pavement was about 104, the temperature of the sheet asphalt pavement itself was 140. That was obtained by boring a hole into the asphalt with a gimblet and inserting the thermometer bulb down into the pavement. These tests were made at a street crossing where there were two or three kinds of pavements, under practically the same conditions. The temperature of the sheet asphalt pavement was 140. The temperature of the asphalt block pavement was 122, and if I remember rightly the temperature of the macadam pavement was about 118.

Mr. Dow: I think it was a little higher than that.

Captain Beach: Since then experiments have been made, taking the temperatures every hour of the day and night on the different pavements for the twenty-four hours, and it has been found that the specific heat of the sheet asphalt is considerably higher than that of asphalt blocks.

President Van Duyne: There is one question I should like to ask Captain Beach. It is with reference to the interesting paper which was read here on the general plan for street extension in the District of Columbia outside of the city limits of Washington. I should like to know how you can prevent property holders from laying out streets to suit themselves? For instance, if a man plats a farm containing a large number of acres, how can he be prevented from improving it to suit himself and laying out streets independent of the general plan?

Captain Beach: Any plan, or subdivision as it is termed here, has to be placed upon record upon the books in the Surveyor's office before it becomes authentic. To do that it has to receive the approval of the Commissioners of the District, and the Commissioners will not approve any plan that is not in accordance with the adopted plan of highway extension.

President Van Duyne: Suppose the party goes ahead independently and builds houses, &c.

Captain Beach: They are allowed to build where they please. The plan is merely one which shows where the streets will come when they are extended. Now they can lay out what might be termed minor streets between the larger streets or principal streets of the plan, but they cannot lay out a public street on any other than those lines adopted by the Commissioners, because it will not be accepted as a public street. street on any other than those lines adopted as a public street. Of course if a man had a mind to cut his own farm up into private roads, that is entirely a matter for himself; but they do not become public streets. The District takes no charge of them, it spends no money upon them, assumes no responsibility for them unless they conform to the adopted plan. The District would lay out no water pipes and construct no sewers.

Mr. Meyers: Could a man in such a case recover any damages for the tearing down of the structures that he might put up in the line of the public streets.

Captain Beach: I presume he could. That question of highway opening has been a rather bitterly discussed question for some years past. It was the intention of some parties to have Congress appropriate money to purchase every street laid down in that plan clear out to the District line. Their argument was that the land could be obtained more cheaply now than it could be at a future time. Of course the estimates of the cost were very divergent. The advocates of the plan I think estimated the lowest cost at about $8,000,000, and the estimates ran up to $40,000,000; and some of the extreme opponents of the plan estimated that the cost would be still higher. The law was amended at the last session of Congress so that it now simply requires all public streets laid out to conform to the adopted plan. The opening of the streets is a matter to be determined hereafter and the question of improvements in the line of the streets is one that rests with the property owners. I think the general feeling is, however, that a man would not be apt to recover very much if he deliberately went ahead and built right in the line of the street.

Mr. Benzenberg: I would ask whether the extension of these highways and streets has been published in any way, so as to serve as a notice to interested property owners, that they might not hereafter pretend that they were unaware of what the District contemplated in the way of future street extensions.

Mr. Richards: The streets are being lithographed now, and will be distributed to all interested persons.

Mr. Fulton: I would ask Captain Beach, if it is not too much trouble, to furnish us with the items that he has secured as to the cost of repairs of sheet asphalt pavements. Most of us in our own cities are interested at this time in knowing what it is going to cost to keep these streets in repair after the guaranty has run out. It is necessary in that connection to have the width of the street and the relative amount of travel, so that a general conclusion can be arrived at.

Captain Beach: I will state in regard to that, that the information can be very easily furnished to the society, but that the entire information is contained in the annual report of the Engineer Commissioner for the District of Columbia for the past fiscal year, which is now in the hands of the Public Printer, and as the society has had some trouble, I believe, in publishing all the papers, with the maps and plans which have been presented heretofore, perhaps it would be as well to obtain the same information from that report as by repeating it in the proceedings of this society.

THE PRESIDENT: Will all the members be able to get copies of that report?

CAPTAIN BEACH: If you will furnish the names, we shall be glad to send copies of the report to all the members who desire them. The report will not be ready for distribution until after the first of December, because it has to be made officially to the President of the United States, and it is not considered courteous to give it to the public before it is transmitted to him.

MR. HEWSON: It may be of some interest to the gentlemen from different sections of the country where the price of asphalt pavements under contract varies so greatly to know that in the City of Newark, N. J., which I represent, we have very recently been going through the throes of a struggle with the asphalt companies, the question being whether the work should be thrown open to competition or whether the paving should be confined to one or two specific makes of asphalt pavement. In 1895 we laid over 167,000 square yards of asphalt pavement, having no competition, the pavements being laid principally by the Barber company at a price ranging from $2.60 to $2.90 per square yard, the average being $2.70 per square yard. It varied because of the variations in the size of the different contracts. A great deal of fault was found with the high price. We heard of other cities which were getting pavements under similar specifications at lower prices. Agitation commenced and in 1896, the following year, we laid about 145,000 square yards, under the same conditions without competition, the company having educated the Boards of Works and Public Authorities and public opinion to believe that they had the only asphalt that would make a good pavement, and that they had the only method of laying good pavements. However, under the aroused public opinion they made a very slight concession and the average cost of 1896 was $2.60 per square yard. In 1897 a very determined fight was made to open the door to general competition under more stringent specifications or under the same specifications. Contracts were held up and the only work done was upon four streets, amounting to only a few thousand square yards. The companies having nothing much to do with their plants came down to $2.35 a yard, and that was understood to be their ultimatum under a five-year guaranty. The fight was continued, however, and in 1898, we have contracts for nearly 200,000 square yards of asphalt pavement under open competition at an average cost of $1.54 per square yard, under the most stringent specifications with a ten years' maintenance, all prior to that under the high prices having been five-year guarantees. The lowest or minimum price, from one of the leading companies, which had a monopoly before and had said that it would not make a lower price, was at the rate of $1.38 per yard. That was the minimum; but another company was so close to them as to bid $1.39. Our first contracts under the new order of things were at $1.45 and then the price got down to $1.38. For short intersections of streets we have to pay a little higher price, making the average about $1.54 for the 188,000 square yards which we laid. And during this year the price for laying all kinds of pavements has dropped greatly. I was much interested in the cost of pavements as given by Mr. Lewis of Brooklyn, as in this year (1898) we have given contracts out for fifty-nine streets. At the low prices property owners came in and were anxious to get their streets paved, and we have laid in round numbers about 300,000 yards of pavement of all kinds, equal to 14½ miles of repavements and new pavements, of which about 188,000 yards have been asphalt on a six-inch concrete foundation, one and a half inch binder and a two-inch surface.

MR. BENZENBERG: Did you say a one and a half inch binder?

MR. HEWSON: One and a half inch binder, made of the same cement as the surface, with the addition only of the broken stone. I should also state that the contract price covers everything. It includes the excavation of the street, removal of the old pavement, the concrete foundation and binder and the cushion or wearing surface complete. We have laid pavement of oblong granite on concrete foundation with a tar filling for $2.13. That is very much lower than we ever got it laid for before, something like 60 or 70 cents per square yard lower. The average price I think was $2.15. And granite pavement on sand, under open competition, we have had laid for $1.40 per square yard.

For brick pavements upon a six-inch concrete foundation with asphalt grouting or cement grouting we formerly paid $2.25 to $2.50 per square yard and we now pay $1.75. So that our nearly 300,000 yards of pavement laid this year has averaged us a cost of about $1.78 per square yard for the best and most modern pavement, laid in the best manner and under the most stringent specifications. Several of the municipal authorities who have representatives here have sent for our specifications, which we have always been glad to furnish.

A MEMBER: In what city is this pavement laid?

MR. HEWSON: The City of Newark, N. J.

THE SAME MEMBER: I did not understand your statement about the price of brick pavements. What did you say it was?

MR. HEWSON: For brick pavement $1.75 per square yard on a six-inch concrete foundation.

THE SAME MEMBER: In Newport, Kentucky, we beat that. We get brick pavement laid for about $1.24 to $1.34. That was the price this summer.

MR. HEWSON: The price, of course, depends somewhat on the locality. In a locality where labor and the shale is plenty, the price is cheaper. We have only this year been able to get down to these prices. Western brick, or Galesburg brick, we could not reach, because the cost of transportation was more than the cost of the bricks and it is only recently that the manufacturers have been so near to us that we could get cheap transportation, and hence lower prices.

A MEMBER: How do you pay your cost of repairs after the five years' maintenance?

MR. HEWSON: We corresponded with the principal cities and specially with Buffalo and received a table of expense from Buffalo, just about as it was read here to-day. You will see that the Buffalo average is pretty near five cents per square yard, and we allow for maintenance and repairs five cents per square yard per year, commencing with the sixth year. So we know exactly what the pavement is going to cost us. We bind the same companies to keep the pavement in repair, and agree to pay them twenty-five cents per yard for the term of five years, payable at the rate of five cents per square yard per year.

A MEMBER: After the first five years?

MR. HEWSON: After the expiration of the first five years.

A MEMBER: And nothing for the first five years?

MR. HEWSON: No, that is the original guaranteed term. We have surety company bonds for the last guaranty in one-half the amount of the contract.

A MEMBER: Then your total cost for the pavement for the ten years is twenty-five cents a yard in excess of the contract price you gave us, or about $1.78.

MR. HEWSON: Yes.

THE SAME MEMBER: I understand then that your pavements cost $1.78, with a ten-year guaranty?

MR. HEWSON: For five years' guaranty, and five years of maintenance after that.

MR. BENZENBERG: The basis you gave then was really for the five-year guaranty?

MR. HEWSON: Yes.

MR. BENZENBERG: With the additional contract of five cents per yard per year for maintenance for five additional years?

MR. HEWSON: Yes, but before that, in 1895 and 1896, we had been paying as high as $2.95, averaging $2.70 for a five-year guaranty and on the question of repairs we, like a great many other cities, were in the hands of the companies. Having no plant of our own we had to pay them for repairs, after the guaranty ran off, the original price.

MR. BENZENBERG: I would ask for information on what classes of streets were these fifty-nine pavements laid—on resident streets purely or residence and business streets combined?

MR. HEWSON: Residential and semi-residential; that is, residential and business. We are a very large manufacturing city with an immense heavy traffic and for our heavy traffic business streets we have granite on a concrete foundation with tar filling. On residential streets where there is the greatest wealth and where the most desirable pavement is required, without regard to cost, we have asphalt. On other residential and partly residential streets we have asphalt and brick. On our roads leading out to the suburbs it is macadam. On our heavy traffic streets we still hold to granite on the score of economy of maintenance.

MR. THOMAS: We have done considerable paving in our town, entirely with brick. Under our specifications when a contractor takes a street he grades down twelve inches below the finished surface of the brick pavement and puts in six inches of gravel and two inches of sand on top of that gravel. First the foundation is rolled with a heavy iron steam or horse roller, and the six inches of gravel and two inches of sand are made to conform with the finished street. On that the brick is placed. We are now laying some at a cost of 85 cents per square yard. The contractor removes the dirt to any point designated by the city, not to exceed one-half mile distance. After the bricks are laid, sand is first swept in the interstices and then the pavement is rolled with a heavy roller, and three-quarters of an inch of sand is put on top of the bricks, to remain long enough to become thoroughly packed. The cost of this as I say is 85 cents per square yard, on an average. Some has been done as low as 75 cents, according to the street.

A MEMBER: What city do you refer to?

MR. THOMAS: Parkersburg, West Virginia. We have about all kinds of brick. First we commenced with common red brick, about ten or twelve years ago. We have had four squares of that relaid this summer. We have had some paving done with vitrified block. They have given us entire satisfaction. We have had some down several years, with no perceptible wear upon them. We have a guaranty of five years on the paving.

CAPTAIN BEACH: Mr. President, I have been personally in the vicinity of Parkersburg and know that part of the country very well. I would state that the prices which are obtained there are due to the fact that Parkersburg is very close to the localities which produce an excellent quality of paving brick. The Muskingum River enters the Ohio River fourteen miles from Parkersburg, and the valley of the Muskingum is filled with all sorts of clay. Marietta, which is fourteen miles above Parkersburg, has laid vitrified brick pavements upon a gravel foundation for fifty-six cents per square yard.

MR. HOLMAN: There is one thing stated by the gentleman from Newark (Mr. Hewson) which I want to make clear. The pavements there, as he says, cost this year an average of $1.53 per square yard, with a maintenance charge of 25 cents for five years, giving him an asphaltum pavement for ten years' maintenance at a total cost of $1.78 per yard. The average cost of Washington's pavements at present is $1.77, and the average cost of maintenance is 3.2 cents per yard for five years, making 16 cents, or a total for an asphaltum pavement constructed and maintained for ten years of $1.93, giving Newark an advantage of only 15 cents per square yard. Now I am informed by the Washington authorities that in many cases their cost of maintenance is much less than 3.2 cents per yard per year, so that in many cases Newark has no advantage that I can see over Washington, although competition is restricted in Washington and wide open in Newark. Am I right in my deduction?

MR. HEWSON: I will ask Captain Beach if the City of Washington has its own plant and does its own repairs.

CAPTAIN BEACH: The repairs of asphalt pavements in Washington are ordinarily let out by contract. The contract which expired on the 30th of last June was for a period of five years. The contract which is now in force, beginning the first of last July, is for a period of two years. I will read from this table a statement of the cost of repairs on a few streets, taken at random, for the first five years after the guaranty period of five years expired; that is, for the sixth to the tenth year inclusive of the life of the pavement:

A street, northeast, 0, 0, 0, .1, .4.

B street, southeast, 0, .9 of a cent, 0, 3 cents, 3 cents, 6.1.

E street, northwest, 0, 2.2, 7.4, 5.7, 10.6, 14.4.

That street was resurfaced in the fourteenth year of its life.

B street, southwest, nothing for the first eight years after the guaranty period expired

H street, southwest, nothing for the first three years; .3 of a cent for the fourth year, nothing for the fifth year. As a rule there is nothing upon the pavement in the sixth year and there is very little upon the pavement in the seventh year. That is, there is very little expense during the first and second years after the guaranty period expires. After the pavement reaches the tenth or eleventh year, then the cost of repair begins.

MR. HEWSON: We have perhaps four hundred thousand square yards of asphalt pavements under a five-year guaranty only. The problem confronting us has been to determine what we are going to do when the five-year guaranty runs out. We have sixty or seventy thousand square yards of pavement running out of guaranty this year. The plan upon which the companies have charged us has been that whatever the contract price of a street was, that was the cost of repair. We think we have solved it by our ten-year guaranty. At least, we know that it cannot cost us more than five cents a square yard for the period of five years succeeding the five-year guaranty. And on those streets where the old five-year guaranty is running off, we think we can get the same terms, which would be a very great saving.

Now, I want to say that the character of the traffic in different cities varies greatly. Captain Beach has mentioned a thing which you have all noticed, that in the city of Washington the streets are very broad, the spaces between the curb and the car tracks are very great, so that the traffic does not come in the car tracks nor close to the rails. But in many of our cities, as is the case in my own city, the streets are very much narrower, many of the streets have double tracks, and traffic is exceedingly heavy. The city of Newark is probably one of the great manufacturing cities in the country and I believe that on some of our streets we have about the heaviest traffic of any city in the country. All these points must be taken into consideration when you consider and compare the question of repairs and the maintenance of pavements.

A MEMBER: I should like to ask whether after the five-year guaranty expires, and you contract for repairs at five cents a yard, whether you pay five cents a yard for the total number of yards laid under a contract or whether you pay five cents a yard for the number of yards that are repaired.

MR. HEWSON: Five cents a yard for the total number of yards laid under contract. That is, if there were twenty thousand yards in a street we pay five cents a yard for the whole 20,000 yards. That fixes it definitely. We know precisely what the repairs of those streets are to cost us, and we can forecast ahead and know what the expense of repairs will be.

MR. MCLAUGHLIN: I wish to state that Adjutant General Barrett, who is here, is interested in municipal matters in Los Angeles. In talking with the general last night, I found that some points which he spoke upon were very interesting, and Mr. Herr, who knows him, and Mr. Byrne, who knows him better than your humble servant, thought that it would be a grand opportunity for this society to spread itself on the Pacific coast by extending an invitation to Adjutant General Barrett to pay us a visit, to see if we could not stimulate both Los Angeles and San Francisco, in fact all the cities on the Pacific coast, to send delegates here or wherever the society meets next year. So I should like to make a motion, if it is in order, that a committee consisting of Mr. Byrne and Mr. Herr, who know Adjutant General Barrett in their own peculiar way, be requested to wait upon the general and invite him here either to-night or before we adjourn and see if we cannot make some impression upon him, to have him when he goes back home insist that those municipalities shall send representatives to this convention next year.

The motion was seconded.

Mr. Herr: Mr. President, it has been stated that our friendship is a peculiar one. The peculiarity of it is that we belong to the brotherhood of Elks. I do not want any improper impression to get abroad on the subject. (Laughter.)

The motion was agreed to.

The President: There was another paper by Arthur R. Reynolds, M. D., of the City of Chicago, Commissioner of Health of that city, that I think you would all be interested in listening to.

Captain Beach: I move that the reading of that paper be postponed until the evening session.

The motion was agreed to.

Mr. Sherrerd: I should like to call attention to one point in Mr. Andrews' paper. He spoke about changing the radius of the curb corners from five to eight feet. I should like to ask him in regard to this. I know it has been the practice in some cities to use the full width of the sidewalk as the radius of the curb corner, this, it seems to me, is rather a bad practice. It is annoying for the pedestrian, because if several persons are walking abreast, one will have to step off the curb before the others. I think there is a point of compromise between what is good for the traffic of the street and what is good for the pedestrian. That point of compromise should be arrived at, it is something about midway or half the width of the sidewalk.

Mr. Andrews: Mr. President, the increase of radius, although it seems to be slight, is really important. It makes a marked difference in the appearance of the street. As Mr. Sherrerd observed, a very large radius is sometimes objectionable. In our streets, many of which are narrow, we unfortunately have many overhead wires and poles, sometimes two feet in diameter, and they have to be placed so that the wires shall pass from one street up another, and on that account alone it impossible, frequently, to use a very large radius. Then the difficulty arises which Mr. Sherrerd mentions, of the non-accommodation of the pedestrian traffic, if you have a very large radius. It interferes to some extent with the crossings. We have found an eight-foot radius the most practical, but sometimes use ten or twelve feet, where the sidewalks are wide. For ordinary conditions I find that a radius of eight feet can be used almost everywhere.

GARBAGE DISPOSAL.

BY ARTHUR R. REYNOLDS, M. D., COMMISSIONER OF HEALTH, CITY OF CHICAGO.

During the year I have had occasion—in such intervals as offered from other and more immediate duties to give some additional study to the question of the collection and disposal of Chicago's wastes, including ashes and garbage.

This study was directed chiefly to the local situation; but the conclusions arrived at have a general applicability which may warrant offering them to the members of the Association interested in the subject. The points dealt with are:

First, the desirability of making separate contracts for the collection and disposal of garbage and for the collection and disposal of ashes and other wastes.

Second, the imperfect state of all methods of garbage disposal as far as examined.

Third, the disparity in the values of the utilizable products of reduction processes.

Fourth, the feasibility of simplifying the collection and disposal of certain wastes by a proper control of the junk trade.

1. The desirability of separating the contracts is suggested by the fact that the bidders are generally men skilled in the handling of garbage only, and not familiar with the conditions which obtain with regard to ashes and other wastes.

Any estimate based on the cost of the collection and disposal of ashes in most cities of the country would be too high for Chicago, because of the ready means of disposal, with short hauls, which this city affords, where clean ashes are in demand and have value for filling purposes. It is probable that most bids are higher than they would be if this fact were fully appreciated, and if the value of the waste paper, rags, metal and other junk collected with ashes were taken into account.

Among other reasons for dividing the contracts may be mentioned the fact that the contractor for the removal of ashes needs no skilled knowledge of garbage collection and disposal. Ashes do not decompose and become a menace to health, as does garbage, if not promptly and properly disposed of.

The penalty for failure in the ashes-removal contract need not, therefore, be so high; and, if divided, either the ashes contractor or the garbage contractor might fail without the one affecting the other. As a matter of fact, the garbage-disposal people do not want anything to do with ashes or other wastes.

Such a division of work would lessen the labor of the city in enforcing the separation of garbage from ashes by the householder, which separation is a prime condition of economical garbage disposal. And it would, moreover, pave the way for the ultimate assumption of the entire work by the city and the abolition of the contract system, which seems to me desirable.

2. Much progress in the various reduction processes has been made during the last few years, but it may be said that garbage disposal is to some extent still in the experimental stage. Within the next few years it is possible, though not very probable, that Lord Kelvin's process for the "extraction of heat and light from garbage" may be available in this country, as it is asserted it already is in Shoreditch, Eng.: or that a still more recent invention may be offered to us—whereby it is claimed that 14,000 feet of illuminating gas are to be obtained from every ton of garbage, at a merely nominal cost.

Aside from these possibilities, it is a fact that inventive talent and large sums of money are being directed to the solution of the garbage-disposal problem, and that the imperfections which were found in every plant examined bid fair to be remedied in the near future. Even in the most successful plants the operators admitted that improvements and alterations were necessary, and claimed that these were already planned and would soon be made.

Whatever process is adopted, however—whether incineration, reduction or conversion into fuel or illuminating gas—it still remains that the handling of garbage in large quantities is attended by certain objectionable features, chiefly the production of offensive and unsanitary odors. This precludes the concentration of any considerable amount of garbage, either for shipment or for treatment, in the vicinity of human habitations.

3. The wide disparity in the quantities and in the commercial values of the utilizable products of the various reduction processes in different localities would seem to be an important element in determining bids. These products are chiefly grease and tankage, or fertilizer base.

Ordinary city garbage yields from 2.4 to 3.9 per cent., or an average of about 3 per cent., of grease, worth at the present market price 2⅛ cents per pound.

The amount of fertilizer base yielded by the different reduction processes varies from 14 or 15 per cent. to about 30 per cent.—average 22.5 per cent. I have not been able to learn definitely the value of this product; but Mr. McDonough Craven, one of New York's experts, fixes—as the result of treatment, by different methods, of 3,000 tons of summer garbage from different cities—its average value at $1.27 per ton of garbage. This is probably a minimum figure; it is certainly much lower than anything I heard mentioned in the different cities visited. For the present purpose, however, it may be accepted in order to illustrate the disparity in the values of utilizable products from garbage reduction.

The average daily output of garbage in eight cities where the garbage collected was carefully weighed for several successive months in 1895, was .57 of a pound per capita, or 208 pounds per year of three hundred and sixty-five days. I was able to get accurate figures of the quantity of garbage produced in only three of the cities visited for the purposes of this investigation—namely, Buffalo, Detroit and Bridgeport. In these cities practically all of the garbage output is collected and accurately weighed. They have an aggregate population of 600,000, and their aggregate garbage collection for the previous twelve months averaged 144 tons per day—equivalent to a little less than half a pound (.48) per day per capita of population.

It will probably be safe to assume half a pound per day for Chicago, and upon the basis of 1,650,000 population—or 30,000 more than the department computes the death rate upon—this would give a daily garbage output for Chicago of 412.5 tons per day, or 150,562.5 tons per annum. This would yield the following quantities and values of grease and tankage, according to the processes employed:

GREASE—

At a minimum yield, 2.4 per cent.—36,135 tons, at $42.50 per ton	$153,573.75
At maximum yield, 3.9 per cent.—58,719.4 tons, at $42.50 per ton	249,557.45
At average yield, 3.15 per cent.—47,427.2 tons, at $42.50 per ton..	201,565.60

TANKAGE—

At average yield of $1.27 per ton of garbage	$191,339.65
At minimum yield of $0.847 per ton of garbage	127,526.43
At maximum yield of $1.693 per ton of garbage	255,152.87

These figures show values of utilizable products from Chicago garbage as follows:

By the least productive process	$281,100.18
By the most productive process	504,710.32
By the average of all processes	392,905.25

These estimates are based on the lowest prices for the products; with a difference of $223,610.14 between the different processes operated in various localities.

Grease is probably worth a third more and tankage three times as much as the prices above given.

I was unable to obtain any authentic data of the relative cost of operating the various plants in the cities visited; but it does not seem probable that there can be any such disparity in the cost of operating as there is between the values of the products; and it must be obvious that, all things considered, the method or system which—with due regard to sanitary conditions and inoffensiveness of operations—gets the most out of the garbage must be the best and most economical.

4. The better regulation of the junk trade—which deals with rags, bottles, waste paper, old rubbish, metals, etc.—has also a bearing on garbage disposal inasmuch as these articles frequently find their way into garbage boxes and so add to the labor, which increases the cost, of handling.

The trade is quite profitable, and I have reason to believe that, if it were properly systematized, its regulation and supervision might be made to yield the city a revenue. Such regulation is demanded also as a sanitary measure as well as for police purposes. Infected rags, bedding, etc., are frequently stored in junk shops without proper treatment; while these places are not infrequently used as "fences" for the disposal of stolen property.

The division of the city into junk districts, the letting of the privilege in each to the highest bidder, the location of the shops where they will be least objectionable, are some of the features of this better regulation which have occurred to me. Many minor nuisances might thus be abated and our streets and vacant lots be kept cleaner and more tidy in appearance.

CAPTAIN BEACH: Washington has had a rather unfortunate experience in garbage disposal, having had two crematories erected which have been removed. The health officer of the district, Dr. Woodward, is present, and I think perhaps he can give us a little information upon these points.

THE PRESIDENT: We shall be glad to hear from the doctor.

DR. WOODWARD: The condition pictured in Dr. Reynolds' paper is like a dream. I think it can only exist in the mind of man and not in actual experience. I am afraid his statements are not the result of actual experience, but that his paper is rather an ideal study.

In the first place I fail to realize any advantage whatsoever to be derived from awarding separate contracts for the collection of ashes and for the collection of garbage. I am aware that there is some advantage from a separate collection, but I think it would be decidedly better to award one contract for both, and for this reason, that the collector can then work his stock and his plant to the best advantage. There is a very wide variation in the amount of garbage collected during the different seasons of the year. The amount of garbage collected is greatest in the summer, when the amount of ashes to be collected is the least; the amount of ashes to be collected is greatest in the winter, when the amount of garbage to be collected is the least; so that a contractor who has, in order to carry out his contract, been required to put in a plant sufficient to meet the maximum amount of work to be done either in summer or winter, can do the work more cheaply if he can use one equipment for both purposes. That is, the garbage contractor will not have idle carts and horses to carry through the winter, and the contractor for the collection of ashes will not have to keep his carts in the stable all summer and pay for the pasturage of his horses. I think the advantage to be derived is rather by letting the contract to one man instead of letting it to two.

So far as concerns the question of not requiring skilled labor to collect ashes, and requiring skilled labor to collect garbage, I fail to realize any particular difference. When it comes to the disposal of the two there is a difference, but in the collection as much skill is required on the one hand as on the other.

Whether the work should be done by contract or whether it should be done, as Dr. Reynolds suggests, by the city, is a question which must be settled by each city for itself, and in my judgment it depends entirely upon the freedom of city government from political control. If the superintendent of that work is able to use his own judgment in the appointment and discharge of men entirely unhampered by political influences, the city could undoubtedly do the work more economically than could a contractor. A contractor with a five or ten year contract, if he is a reasonable business man, must establish a sinking fund on either a five or ten year basis, whereas a city can use any plant which it may install for the full length of the life of the plant, so that aside from political influence, certainly a city should own and operate its own plant.

As to garbage disposal, to which Dr. Reynolds refers, he seemed in most places to use the word disposal as synonymous with reduction. It is not so by any means. Garbage disposal may be either by incineration or by reduction. I do not believe that garbage reduction is any more entitled to be classed as the only method of garbage disposal than is incineration. Dr. Reynolds presents alluring figures as to the value of Chicago refuse, but are they accurate? They may be accurate as to the gross value of the garbage. Garbage may be worth, as has been stated, as much as $2.67 a ton, but what is it going to cost to get that $2.67 out of it? I believe it will cost very nearly as much as that, and probably more. The fact that Dr. Reynolds, as he states, has been unable to secure any reliable figures as to the cost of operating utilization plants, is very suggestive. It would be a very unwise policy to work a mine which contained valuable minerals where the amount of the mineral was not equal to the cost of getting it out and I do not believe it will pay to work garbage that only contains a value which is less than the cost of getting the value into marketable shape.

The amount of grease stated to exist in garbage is probably a little too high, at least that has been the result of my own study. I think, however, that is a matter that will have to be determined in each city. It depends not only on the time of the year but also on the character of the population. The garbage from a wealthy district, where people are extravagant in the use of meats, and careless as to the waste of butter and lard, and other animal food products, is much more valuable to the contractor than is the garbage from a poorly settled district. It contains in the first place a greater amount of fat, and the fat is the really valuable part of garbage.

In the second place it contains a greater percentage of meat, and it is the meat or the animal matter which adds to the value of the tankage. The value of the tankage which is stated at a dollar a ton, is possibly too low, but the value of the tankage is determined by its fertilizer value, and from what I have read and seen, I think that ordinarily it has a merely nominal value for such use. The amount of nitrogen in it and the amount of phosphate is ordinarily very small. The valuable part of the garbage is the grease and the tankage, and to effect this we have the amount of water the disposal of which is a very costly item. After heavy rain or freezing or heavy snows the cost of getting the tankage and the grease out of the garbage and into marketable shape is very considerable, so that I do not believe that it has by any means been demonstrated that any reduction plant can be operated on a paying basis. There is reason to believe that it can be done, but I do not believe there is any satisfactory proof that such is the case.

As to commercial values, that is a matter for the markets to determine; the more reduction plants are put up the less will be the commercial value of their products. The tankage is not, I understand, used as a fertilizer itself, but merely as a filler for other fertilizers, used for the purpose of standardizing them.

The proposition to regulate the junk trade in order to dispose of any of the city waste hardly appears to me to be feasible. Reference is made by Dr. Reynolds that there is difficulty in requiring the separation of garbage and ashes. If there is difficulty in requiring the separation of garbage and ashes, there would certainly be much greater difficulty in requiring the separation of various kinds of junk, of old rags, old paper, old tin cans and everything else, so that the junk man will buy or remove them. There is, however, no real difficulty in requiring the separation of garbage and ashes. It is only a matter of local habit. Here in Washington, where such regulations have been enforced for I think for twenty-five or thirty-five years, there is no trouble in having ashes and garbage separated. We never have ashes in garbage. The most we are troubled with are tin cans and bottles and there is no great trouble from those.

I think the whole matter of garbage disposal is in the experimental stage. Here we have had, as Captain Beach says, an unfortunate experience. Five or six years ago the city was led into adopting a reduction process. Reduction processes were then much more crude than they are now. The plant was the cause of numerous complaints, indignation meetings, and everything of that kind. The Commissioners were annoyed by protests, which they were unable either to verify or to disprove, and a kind providence stepped in and the plant was burned down, so that there was no more trouble from the reduction process. That plant was undoubtedly crude. From an inspection of the remains, which is all I have ever seen of it, I have no doubt that there was some ground for the complaint. The handling of the garbage and the various products was not nearly so carefully regulated as it would be now in any reduction process at present in use, and I have seen most of them.

After that the contractors were allowed to bid for any process they might choose to submit, but the process of cremation was selected. The contractor was required to put up two crematories satisfactory to the commissioners. One of the crematories selected was what is known as the Brown crematory, similar to one formerly in use in Wilmington, Delaware. It is similar in many respects to the Dixon crematory, and also, in some respects, to the Engle crematory. It did its work without nuisance, and was designed to burn seventy-five tons every twelve hours, but there was nothing said as to whether the twelve hours should be consecutive hours or not. Nothing was said as to whether the garbage contractor should be entitled to deliver garbage during those twelve hours. As a matter of fact, in a practical test, the best that crematory could do was seventy-five tons in twenty-four hours, but it could burn seventy-five tons in twenty-four hours without nuisance. Fortunately the contract for its erection was between the builder and the contractor for the collection of garbage, not between himself and the city, so that the city lost nothing.

The second crematory was of the Smith pattern. That is similar to the one that was in use in Atlantic City and to two that were in use in Philadelphia. But the engineer in charge of its erection undertook to improve it. The trouble with the other crematories of the same pattern had been the leakage from the bottom of the cell. The garbage was not burned on grates but immense cylindrical cells, and naturally the water in the garbage leaked out of the doors at the bottom of the cell, which were placed there for the purpose of drawing the ash. Whether the failure of that crematory was due to the improvements or not I am unable to state, but it was certainly a failure and had to be closed. The result was then that the city was left with a crematory which could burn the daily collection of garbage in winter, but could not in summer, and rather than undertake to divide the disposition it was thought best to give the contractor permission to remove his garbage down the river on scows, as he had formerly done, and there dispose of it on a farm belonging to himself by ploughing it into the land. That contract is at present being carried out. This farm, however, was not accessible by railroad, and in order to meet the difficulty which might arise by the freezing of the river, the contractor is required to keep the Brown crematory in such condition as to be ready for use. The present system of disposing of the garbage in the District of Columbia is, therefore, by means of the scowing down the river, and putting it on the land so long as the river is open, and at such periods as the river is frozen and whenever, for any other reason, it may become impossible to take the garbage down the river in boats, it must be burned in the Brown crematory. That system is working satisfactorily to us and satisfactorily to the contractor who, I believe, makes considerable more money out of it than he would out of incineration.

The collection of garbage here is made from the yards. Householders are not allowed to set it on the public streets nor in the alleys. They are required by law to provide a water-tight metallic receptacle, with a tight cover, and those receptacles are not allowed to be smaller than of three gallons' capacity or larger than ten gallons. The contractor is required to distribute cards announcing to the householder the days on which he will collect garbage, that is, announcing the days during those seasons when he collects only twice a week or three times a week; during the daily service merely the frequency of collection is stated. The garbage is hauled in a cart that is probably familiar to some of you, known as the Flannagan cart, a semi-cylindrical steel body revolving on an elevated axle, so that it is easily dumped, and which is free from angles and therefore readily kept clean.

The service rendered is a daily service from April 15th to November 1st in the city itself, and during that period it is a tri-weekly service in the more densely populated suburbs of the city. In the winter season, from November 1st to April 15th, there is a semi-weekly collection over the entire city and more densely populated suburbs. The contractor is required to collect and dispose of garbage; he is also required to collect and dispose of dead animals; and for the entire service the city pays $57,000 per annum. The contractor is subject to fine for failure on his part to collect garbage or dead animals, and if the failure is a gross one, that is, if in the case of dead animals he fails to collect after ten hours' notice, the city has the privilege of collecting such animal and charging the cost to the contractor to the extent of $10; similarly, if he fails to collect any specified garbage after twelve hours' notice, the city can cause it to be collected and charge him whatever it may cost up to $10; so that any single failure on his part may result in a loss of as much as $15 to him, by way of fine and the cost of collecting. The imposition of such fine and cost of collection under the provisions specified is left discretionary with the health officer. As a result of that we have a very good collection service.

For the fiscal year ending June 30, 1898, the total amount of garbage collected was 23,167 tons, giving an average per day of 63.47 tons or an average per thousand inhabitants per annum of 82.66 tons. The amount collected at each collection is left out of this statement, but, of course, it is somewhat greater than the amount collected daily, because there are not as many collections as there are days in the year, for while, as I have stated, there is a daily collection between April 15th and November 1st, between November 1st and April 15th, during the winter season, there is only a semi-weekly collection.

During the same year there were collected 10,129 dead animals, including the smaller and the larger dead animals, an average of 27.75 per day.

The entire number of complaints received during the whole year was only 571, an average of 1.56 per day. And of these complaints certainly not more than 50 per cent. and possibly not more than 40 per cent. were justly chargeable to the contractor, because householders are very apt to complain that their garbage is not collected, without stopping to inquire whether it is the fault of their servants or the fault of the contractor. In certainly 50 per cent. of the cases we find that the fault is due to neglect on the part of the householder or his servant.

From the amount to be paid we deduct certain fines and we pay the weigher, the man who has charge of the scales and who counts the loads at the wharves. The amount so deducted during the year for which I have given the figures was $782.50. Practically the amount received by the contractor was $56,000. For a daily service in this District the average number of vehicles in use was 56. The maximum is about 65. For a semi-weekly service the number required was about 30. The number of horses required in summer averaged 62 and in winter 36. The number of men employed in summer was 56 and in winter 30. This shows from our own local conditions the correctness of the point I have made that the contractor who has to collect both ashes and garbage could do so more cheaply than one who has to collect but one. The garbage contractor must have at least sixty carts, but in the winter an average of 26 of those carts are idle. He must have certainly 62 horses, but in the winter he needs only 36. The number of men employed is 56 in sumemr, but as the winter season comes on he must discharge 26 of them. The discharging of those men and the employing of green help in summer is of course always a source of trouble in the early part of the season.

As the result of my own observations I think the best system of garbage collection and disposal I have seen, has been that in Detroit. With Dr. Reynolds I think that any system of disposing of garbage must be located at a distance from the thickly populated parts of a community. Here we are embarrassed somewhat for transportation. The bidders on the last contract said they were unable to make any terms with the railroad companies for the transportation of such materials at all; but in Detroit the garbage was collected in a steel cart body which was taken to the station, where it was removed from the running gear and put directly on the body of a flat car. The bodies of the wagons, as they came in, were lifted clear of the running gear and a clean body put on. In the early hours of the morning or the late hours of the night the car was attached to a freight train and carried out a distance of sixteen or twenty miles from town and there disposed of, in that instance by reduction. The system to be employed in disposing of garbage that far away from town is of very small sanitary importance. From the financial aspect it pays, because the sanitary and economical aspects of garbage reduction are certainly opposed; and a nuisance which in a city could only be prevented by expensive devices can at that distance from the city be ignored. That is, if it be more economical to cool your tankage in the open air, you can do it. If it is more economical to run your foul water into a piece of land and dispose of it by irrigation or filtration you can do it. You have not, for instance, got to do as you have to do in the vicinity of a large city, that is, to dispose of the water by evaporation.

The system of "garbage" disposal to which reference is made, whereby power is secured from the garbage, is different from what we have in Washington. The word garbage as there used includes not only what we include in the term garbage, that is, pure swill from kitchens and market house refuse, but includes also waste paper, waste from stores, and, I think, ashes. That is all put in a furnace, burned, and the waste heat utilized. Here we dispose of our kitchen swill and market house refuse independently of all other forms of refuse. I regret to say that the city does not even collect refuse of any other sort; neither ashes nor general refuse. If you can collect all of your waste, I think certainly you would do as well to collect the garbage and general refuse together and collect the ashes separately. The ashes, of course, tend to check any fire into which they may be introduced, unless they are screened. On the other hand, general refuse, such as waste paper, sweepings from stores and factories, tends to absorb moisture from the garbage, and adds valuable fuel to the material if it is to be burned. I think it will be well, therefore, when we finally establish both services to collect our ashes separately from the other refuse. The ashes, of course, can be readily disposed of, but the other refuse cannot. It may be possible, then, to generate heat from the waste and to utilize it, but under the present system I think it is entirely impracticable.

The crematory in use in Montreal, like the crematories in use on the other side of the water, burns all sorts of refuse. There in that northern city, where they collect everything together and where they have, of course, very long winters and very great quantities of ashes, they collect their garbage and refuse of all sorts and dump it directly into a furnace, where it is all burned. No fuel is added, and they find they get along without it. Of course, there is waste heat. The foreman told me they had had a boiler in the stack and operated it successfully when they needed, but that they had taken it out because they found that when they wanted to clean the boiler they had to shut down the crematory. There were considerable quantities of smoke coming from the stack, and the stack fire was seldom used.

On the whole, then, I think you will finally come to the conclusion that the most practical method of collection is to collect the garbage and general refuse at one time and ashes at another. The ashes may be screened, and the fuel and cinder used possibly to help burn the garbage and refuse, but the garbage and refuse will, I blieve, be best burned separately. The ideal system of collection and disposal will probably be the collecting in a cart body and transporting by rail outside of the city without dumping; and until the chemist and the engineer have improved present methods, I do not believe anybody will make a fortune out of garbage reduction.

Mr. Jones: I have listened with a great deal of attention to the remarks of the gentleman who has just taken his seat. It perhaps might be of some interest to the meeting if I outlined briefly the system that we have adopted in Toronto. The municipality owns all its own carts and its own horses. In fact, I have gone so far, as the head of the department, to employ my own blacksmith, my own wheelwright, my own harnessmaker. By this means I go outside our own shops for nothing but the raw material. I find that the work can be done more satisfactorily to citizens generally and I think with more economy in that way. At the present time we have 120 horses and carts. In the summer time our collection, unlike that in other cities, is a great deal smaller than it is in the winter time. In the summer time we utilize part of these horses for the collection of garbage, and the others for street watering. I may say that our collection means everything: the cleaning up of lanes, the collection of ashes, and the refuse from the kitchens. In our climate, of course, in the long, cold winter a great deal of coal is burned, and I find that what we call garbage is a great deal heavier during the winter months than during the summer months. Of course, I have no street watering then, and I turn all my force to the collection of garbage, in which there is very little kitchen refuse, but a very large amount of ashes. Of course, we do not need to burn the ashes, but we have at the present time two crematories and the objectionable matter is burned.

Last year we collected 35,193 loads of what we call garbage, that is, kitchen refuse, the sweepings of large warehouses, lanes or alleys. That was taken to the crematory for garbage and burned. As the last speaker said, I suppose the rags, waste paper and things like that assisted to burn the portion of the garbage which is of an objectionable nature.

The ashes collected last year were 77,343 loads, making a total of 112,433 loads collected. The appropriation for that was $56,000. We kept up our plant, renewed what needed to be renewed, did the work complete, built some new carts and bought some new horses, and so on, out of this fund.

I am satisfied that municipalities can control work of this class much better than a contractor will. The object sought to be attained by our department, and which should be the object with every department, is to get the best value to the city for the money expended. We very seldom get any complaints. Just as the gentleman said a minute ago, there may be a few complaints, but they are generally owing, perhaps, more to the neglect of the parties making the complaints than to any fault on the part of our collectors. We employ the very best men we can get for that class of work. Their positions are permanent as long as they faithfully discharge their duties and give us very little trouble.

We are considering whether it will pay to burn only the objectionable matter in the garbage and separate the other stuff collected. I am looking into that question now. I believe they are doing that in New York to some extent, and I intend, before returning home, to look into the matter. It is a question whether we can find a market for the material collected or not. If we can, I think it will be a source of revenue. I refer to old bottles, rags, etc. I do not know whether we have a market for it.

I think the collection and proper disposal of garbage is a question that should engage our municipal officers perhaps a little more than it has in the past. I know it is conceded upon all hands that the cleaner a city is kept the healthier it must be, and I am glad to see the association taking it up in this way. I was a little disappointed last year that that matter was not touched upon. I think it is one to which this society should give its earnest attention, and I am satisfied that good results will follow. (Applause.)

REPORT OF THE COMMITTEE ON MUNICIPAL DATA.

CHARLES CARROLL BROWN, BLOOMINGTON, ILL., CHAIRMAN.
LANSING H. BEACH, WASHINGTON, D. C.,
ALMON D. THOMPSON, PEORIA, ILL.,
Committee.

To the American Society of Municipal Improvements:

Gentlemen: Your Committee on Municipal Data assumes that it was appointed in accordance with the recommendation of August Herrmann in his annual address as President of the American Society of Municipal Improvements at its meeting in Nashville, Tennessee, in October, 1897, contained in the following extract from that address:

"I would further recommend that a special committee to be known as a Committee on Municipal Data, be appointed, and that this committee be instructed to formulate a plan providing for the enactment by Congress of the necessary legislation looking towards the more complete establishment and maintenance by the Government of a National Bureau of Municipal Data, with a view of having collected through it, annually, and formulated for publication and distribution, a complete report with respect to municipal and public work of all kinds, showing the kind and quality of material used, the methods employed, the comparative cost thereof, the results obtained, the manner of using it, the conditions under which the work has been done, the manner of payments and guaranty, and such other information of importance relative thereto as the committee may deem advisable. The same to be submitted for the consideration of the society at its next annual meeting, and if it meets with the approval of the society, that such steps be taken at that time as may be necessary, with a view of having the same transmitted to congress with a recommendation that laws be enacted to put the same into effective operation."

Your committee has carefully considered the matter intrusted to its charge and fully concurs in the opinion of Mr. Herrmann, expressed in a letter to its chairman, in which he says: "I think it a very important department, and if ever established by the government will be very useful to all municipalities throughout the country, and I have no doubt but that, if your committee brings in a proper report, and the members of the society woud take a proper interest in the matter with their congressmen of the localities which they represent, the matter can be successfully arranged."

Several methods of procedure are open, of varying degrees of importance, and the difficulties of setting in motion the machinery necessary to carry the projects to a successful issue, and the time necessary therefor, are in inverse ratio to their importance. All these modes of procedure are open to us at once, and we think that progress can be made in all at once, that in the more comprehensive plans being greatly aided by the work done in the less important lines.

1. The simplest portion of the project is most nearly under the control of the membership of the society.

An examination of the annual reports of municipal departments shows great lack of uniformity. Much of this is due to the great differences in methods of keeping accounts, and of beginning and carrying forward public works, on account of the differences in state laws, in city charters and in local conditions. Your committee is of the opinion, however, that the variations in form and matter of reports can be reduced very greatly by agreement to follow, as closely as laws and fixed methods will permit, forms of report proposed by such a body as this and recommended by you and by competent governmental authority as models for the municipalities of the nation.

There are in many reports evidences of lack of co-ordination of departments; of duplication of reports, under circumstances such as to render them even contradictory of each other; of separation of work among several departments which should properly belong to one; and of consequent inability to obtain any adequate idea of the economy of operation of the departments, and to prevent duplications and omissions, which produce waste and serious difficulties. Co-ordination and co-operation of departments will be facilitated by forms such as are proposed, if the city departments are required by law or ordinance to co-operate in giving full information upon the various items of the schedules, in their annual reports.

Many reports, especially among the smaller cities, are very meager in their statements regarding the operation of the departments in their technical details, while they are very full of detail as to the exact amount paid on each individual voucher allowed during the year. The forms proposed, so far as they are applicable, will bring order out of this chaos, and enable the authorities to see the extravagance or economy of their methods of construction and operation.

Many other points of a similar nature might be made.

It is doubtless true that circumstances vary so greatly in different localities that comparisons of operations in different cities are not very satisfactory, and in some cases are very misleading, but the fact remains that very valuable conclusions can be drawn from general comparisons of this sort, and much important information gathered from the study of such reports. The schedules presented herewith are intended to cover the larger items, such as can most readily be compared in reports of different municipalities, but they are also intended, as indicated therein, for models upon which to form other more detailed schedules, covering the most minute items of construction and operation. The comparison of reports made on such schedules from year to year, is perhaps the most valuable use to be made of the scheme, an intelligent study of the reports enabling the authorities to discover the places where errors of judgment have been made, and to determine where improvements may be made in methods, and the results of adopted courses of procedure. The exact forms of these detailed schedules depend so closely upon the local circumstances and the personal preferences of the supervisors of the work, that they are left to the judgment of these officers, without recommendation.

The general lines of reports are so nearly alike in the nature of the case, that it is believed the forms presented, when modified by the combined wisdom of the society, can be closely followed to great advantage, individually and collectively, by practically all cities.

The committee presents forms of waterworks reports prepared by the chairman, of sewerage reports prepared by Mr. Beach, and of street reports prepared by Mr. Thompson, each having had special opportunities of study in the line assigned to him. The committee suggests that forms for other lines of municipal work be prepared by experts in those lines, to be added to these forms if they are deemed worthy of adoption by the society, and recommends the formation of and schedules for gas and electric lighting, garbage collection and disposal, street cleaning, sidewalk construction, and the addition of such others, from time to time, as are demanded by the extension of municipal activities.

2. One of the duties of the next session of congress will be the establishment of a Bureau for the Census of 1900. A beginning was made in the last census in the collection of municipal data, but those of us who have tried to extract anything from the data offered have found the reports of little value for most purposes. This is due, largely, of course, to the incompleteness and lack of uniformity in the information furnished by the municipalities, but is due, almost as largely, to the form of report adopted and the lack of system in many of the classes of items on which information was requested.

It is therefore recommended that, when the schedules are amended, enlarged and adopted by the society, a resolution be adopted recommending the adoption of the schedules by the Census Bureau as the forms for reports requested by that office from the municipalities of the nation, and that a committee be appointed to present this resolution to the proper authorities at the proper time, to press it upon their attention, and to secure adoption if possible.

3. The establishment of a new bureau in any department of the government is a serious matter, requiring much thought and great labor. To what department the Bureau of Municipal Data prepared by Mr. Herrmann should be assigned, is the first question for consideration.

It is the opinion of this committee that a permanent Census Bureau is a desideratum. The collection of municipal statistics pertains properly to such a bureau. Your committee, therefore, recommends the passage of resolutions recommending the establishment of a permanent Census Bureau, with powers and facilities for collection of various kinds of statistics at any and all times as required by Congress, and for the inclusion of a Bureau of Municipal Statistics in the premanent provision for departments in such permanent Census Bureau; the appointment of a committee to present this resolution to Congress in such manner as they may deem most effective; and an appeal to the municipalities represented in this society and at large, for aid in presenting the matter effectively to congressmen and others of influence in shaping such legislation, such appeal to be presented in such manner and at such times as the members of the committee and the Executive Board of the society shall deem expedient.

The schedules for reports mentioned in this report follow as an appendix hereto.

Respectfully submitted,
CHAS. C. BROWN, Chairman,
LANSING H. BEACH,
A. D. THOMPSON,
Committee on Municipal Data, A. S. M. I.

PROPOSED FORMS OF WATERWORKS REPORTS.

The following schedules, proposed as forms of waterworks reports, have all been taken from forms of municipal waterworks reports in actual use. No one report contains all of them, but every item in every schedule is used in some such report. It is not probable that any one report would require all the schedules proposed. The attempt has been made to give forms for all the general schedules that might be required by any system of management in use. Many additional forms for reporting details are used by various waterworks authorities, but no attempt has been made to cover this part of the field, the diversities in methods of keeping accounts being too great, and the importance of such reports being too slight, to make this desirable. Some may consider that too many schedules have been given, but it is probable that all would not agree on the omission of any one schedule. They are presented with the hope that cutting down will be deemed necessary rather than additions.

WATERWORKS OF THE CITY OF ——————— ———

County, ——— State. Year ending ——— ——, 18——.

Population by census of 1890. Of 18——. Estimated at date.

Ownership of works.

Dates of construction. Items.

Sources of supply, whether lake, river or stream, springs, wells, deep or surface.

Mode of supply, whether gravity from storage or distributing reservoir, pumping to storage or distributing reservoir, direct pressure, with or without standpipes.

Reservoirs. Size and capacity of each, with elevation above points stated.

Standpipes, size and capacity.

Settling basins, size and capacity.

Filters, kind, size, and capacity.

Wells, number, kind, size, depth, level of water pumps working and not working greatest and least supply.

Pumping plants, size and capacity of each engine, totals for each station and for entire city. Boilers, number, size and rated capacity.

Pressure at pumps, maximum and minimum pressure in pipe or distributing system. Additional for fires.

Suction lift in feet.

Total miles of pipe.

Total number of service connections.

Total number of hydrants.

Total number of meters.

Total number of public fountains and watering troughs.

TABULAR STATEMENT OF ENTIRE ISSUE AND REDEMPTION OF BONDS.

Heads of columns are as follows:

Number of issue.
Authority for issue.
Date of issue.
Date when payable.
Amount.
Rate of interest.
Amount redeemed.
Date of redemption.
Amount outstanding.

Right hand column contains the numbers of the consecutive issues of bonds, with line at foot for totals.

TOTAL COST AND PRESENT VALUATION OF WORKS.

(This table contains all items that can properly be charged to construction, and does not contain any that belong properly to maintenance and repairs.)

Heads of columns are as follows:

Real estate, including lands and buildings, giving as many sub-items as may be desired.
Reservoirs and standpipes, with sub-heads for each and for total of all.
Pumping system, with sub-heads for each and for total of all.
Supply mains.
Distribution system:
Service connections.
Meters.
Engineering.
Administration, including office and field outfits necessary.
Total cost of works.

The right hand column contains in order:

The consecutive numbers of years since construction began.
The total costs of constructions.
The total amount deducted from cost at date of last report for constructions abandoned, replaced, or otherwise disposed of.
The amounts so deducted during the year.
The totals of the two preceding lines.
The present valuations, being the differences between the total costs and the total deductions.

ANNUAL RECEIPTS.

Sales of water—
  Regular rates.
  Special rates.
  Meter rates.
  Meter rents.
  Fire hydrants.
  Street sprinkling.
  Delinquent rates.
  Other city purposes.
  Miscellaneous.
Connections, including materials.
Permits and licenses.
Other special items as desired.
Total receipts from operation of works.
Bonds.
Interest.
Direct taxes (frontage, etc.).
City tax levy or appropriations from general funds.
Real estate, sales or rentals.
Sales of other property.
Grand total receipts for the year.

ANNUAL DISBURSEMENTS.

(Details of each of the following items should be given in separate statements with the minuteness desired.)

General items—

- Refunds.
- Interest.
- Bonds retired.
- Sinking fund.
- Paid to city funds.
- Stock on hand and cash balance on hand to balance statement of receipts.
- Total of general items.

Construction. Supply system—

- Reservoirs and standpipes.
- Intakes and wells.
- Filters.
- Meters.
- Pumping works, buildings and ground.
- Pumping works, engines and boilers.
- Ships and other buildings.
- Supply mains.
- Engineering.
- Total of supply system.

Distribution system—

- Street mains.
- Tapping or Plumbing department.
- Total of distribution system.

Total of all construction.

Maintenance and repairs—

- Reservoirs and standpipes.
- Intakes and wells.
- Filters.
- Buildings and grounds.
- Engines and boilers.
- Shops and other buildings.
- Supply mains.
- Street mains.
- Other items as desired.
- Total maintenance and repairs.

Operation. Pumping expense—
- Salaries and labor.
- Fuel, including delivery.
- Supplies. (Oil, waste, etc.)
- Total plumbing expense.

Service connections—
- Meter service.
- Hydrant service.
- Transportation of men and materials.
- Office salaries and labor. Administration.
- Total cost of operation.

Total disbursements.

COMPARATIVE STATEMENT OF OPERATION.

Heads of columns are as follows:

Year.
Receipts from operation of works.
Total operation expenses.
Total maintenance and repairs.
Net earnings above total operating, maintenance and repairs.
Interest on bonds paid, stating whether from water works receipts or from city funds.
Sinking fund payments made, giving similar statement.
Total gallons of water pumped.
Revenue per million gallons.
Total cost of operation maintenance and repairs per million gallons.

Right hand column gives numbers of consecutive years since works began operation.

COMPARATIVE METER STATEMENT.

Heads of columns are as follows:

Year.
Number of water takers.
Number of meters.
Total amount of water consumed.
Amount estimated as used for public purposes, not metered.
Total amount of water metered.
Total receipts for water.
Total receipts for metered water.

Right hand column gives consecutive numbers of years since works began operation.

WATER PIPE IN USE.

Heads of columns are as follows:

Size and kind of pipe.
Length in use at beginning of year.
Length added during the year.
Length discontinued during the year.
Length in use at end of year.
Total cost.
Per cent. each size is of the total length of pipe in use.
Per cent. each size is of the total cost of pipe in use.
Number of service connections.
Length of service connections. (Each size if desired.)
Number of hydrants.
Number of valves.

Right hand column has line for each size and kind of pipe and for total.

COST OF PIPE LAYING.

Each line may be described as follows:

Location of line.
——— ft. of ——" pipe, weight ——— lbs., cost $———.
Pipe inspection cost.
Valves, No.——, Size——, Cost, $———.
Fire hydrants, No.——, description———, cost, $———.
——— ft. ——" hydrant pipe, cost, $———.
Special castings, description———, No. ——, lbs. ——, cost, $———.
———lbs lead, cost, $———.
Coal, packing and incidental cost.
Labor, cost.
Total cost of pipe laid.
Cost of paving.
Total cost complete.
Average cost of labor per foot.
Average cost of pipe laid per foot.
Average cost of pipe laid and paving complete, per foot.

TABLES OF PUMPING RECORDS FOR THE YEAR.

(One for each pump or each group of pumps acting together.)

Heads of columns are as follows:

Month.
Days pump was run.
Hours pump was run.
Number of revolutions.

Average number of revolutions a minute.
Pump cylinder dimensions.
Length of stroke.
Number of gallons pumped.
Total for all engines in group.
Average per 24 hours.
Pounds of coal consumed, including all used for pumping, banking, heating, etc.
Steam cylinder dimensions.
Average steam pressure———, maximum———, minimum———.
Average water pressure at pump———, maximum———, minimum———.
Average suction lift———, maximum———, minimum———.
Total lift of water, including friction.
Pounds of ashes removed.
Duty per 100 pounds of coal.

Right hand column contains a line for each month in the year, total for the year and averages.

COST OF PUMPING.

(Table for each station.)

Population served if possible.
Builder and kind of each pumping engine, and cost.
Number and kind of boilers, size and cost.
Cost of station buildings and other appurtenances. (Divide into independent groups if more than one group in station, for the following items.)
Daily capacity of each engine.
Hours each pump was run during the year.
Days each pump was run during the year.
No. gallons pumped a day; average———, max.———, min.———.
Total gallons pumped in year.
Average feet lift, including friction. (Delivery pressure and suction.)
Average feet lift, static.
Pounds of coal used during year, including wood reduced to coal and with no deductions for heating or other purposes about station.
Kind of coal used, size and brand.
Cost per 2,000 pounds delivered at station. (If different kinds of coal are used, separate into items for each kind; or, if this is impossible, give average cost per ton of all coal used.
Pounds of ashes removed.
Gallons pumped to stated average lift with 100 pounds of coal.
Gallons pumped 100 feet high with 100 pounds of coal.
Duty of engine per 100 pounds of coal.

Quarts of engine oil used.
Quarts of cylinder oil used.
Total cost of fuel during the year.
Total cost of labor in pumping for the year.
Total cost of oil, waste and supplies for the year.
Total cost of ordinary repairs in pumping for the year.
Total cost of pumping for the year.
Average cost of each above item for 1,000,000 gallons to given agerage lift.
Average cost of each above item for 1,000,000 gallons to lift of 100 feet.

MONTHLY CONSUMPTION OF WATER.

Heads of columns are as follows:

Month.
Number of gallons pumped.
Metered.
Not metered and waste.
Average daily consumption.
Average per capita on estimated population.
Number of takers, or taps.
Number of meters.
Estimated number of consumers.
Maximum day's consumption or pumping.
Minimum day's consumption or pumping.

Right hand column gives names of months and total.

COMPARATIVE STATEMENT OF CONSUMPTION.

Heads of columns ars as follows:

Year.
Population, census or estimated.
Estimated number of consumers.
Total gallons pumped per year.
Average gallons pumped per day.
Average gallons per inhabitant per day.
Average gallons per consumer per day.

Cincinnati keeps a balance sheet in about the following form, which may be of interest to some:

BALANCE SHEET FOR YEAR 18——.

Heads of columns are as follows:

1. Names of ledger accounts.

Totals of each ledger account—

2. Paid out.
3. Received or on hand.

Operation—
4. Paid for maintenance and expenses.
5. Received for rents, sales, etc.
Construction—
6. Paid.
7. Footing of previous column entered in this to balance represents total cost of construction.
Valuation of waterworks—
8. Footing of the following column entered in this to balance represents total value of works (net capital).
9. Value at beginning of year and additions during year entered in this column.
Balances—
10. Assets.
11. Liabilities.

(Columns 2 and 3 have same total. The balance of columns 4 and 5 goes to column 8 or 9, usually 9. The balance of columns 6 and 7 goes to column 10. The balance of columns 8 and 9 goes to column 11. Columns 10 and 11 have the same total.)

The items in the right hand column may be carried to any desired degree of detail. The following are suggested after a study of those given in the Cincinnati report. Each item appears in columns 2 or 3 or both, and in others, as stated below:

Names of ledger accounts.
Total valuation of waterworks to column 9.
Waterworks bonds to 11.
Sinking fund to 10.
City Treasurer to 10 or 11.
Interest account to 4.
Cash account to 10.
Water rents to 5.
Office expense to 4.
Office fixtures to 6.
Pumping stations, items for each station—
  Maintenance to 4.
  Construction to 6.

Reservoirs, standpipes, tanks, items for each one for maintenance and construction, to 4 and 6 respectively.

Street mains—
  Extension to 6.
  Repairs to 4.

Supply mains—
    Extensions to 6.
    Repairs to 4.
Hydrant service to 4.
Tapping service to 5.
Engineering department to 4.
Repair department to 4.
Administration to 4.

Erie, Pa., carries a statement of the standing of the account of the waterworks with the city, which shows whether the works are self-sustaining or not, and to what extent they are paying for themselves, when all allowances are made. The items of the account are as follows:

Due from waterworks to city at last report.
Received from bonds issued during the year.
Received from taxes or appropriations during the year.
Interest on first item above at rates of interest of outstanding bonds, remainder at 4% for one year.
Interest on new bonds issued from date of issue to end of year.
Office rent if in city building.
Total.
Cash to city funds. (Designate.)
Water furnished city. (Items and amounts to be charged therefor.)
Total.
Balance due from waterworks to city at date of this report.

Following are headings of other tables that may be desired by some from time to time:

Hydrant locations.
Valve locations.
Pipe distribution.
Comparative statement of yearly pipe laying.
Meter distribution.
Service pipes added, discontinued, and totals.
Permits issued.
Buildings examined.
Rainfall records.
Fire alarms.
Rate sheet.
Present valuation of works.

PROPOSED FORMS OF STREET CONSTRUCTION REPORTS.

PAVEMENTS. CITY OF————. STATE OF————.

GENERAL STATISTICS.

Heads of columns are as follows:

(Items of information.)
Asphalt—
    Sheet.
    Block.
Brick.
Wood—
    Cedar block.
    Pine block.
Granite.
Sandstone.
Limestone.
Cobblestone.
Miscellaneous pavements.

The right hand column of items of information contains the following lines:

Total square yards in city.
" miles " "
Square yards laid in 18——.
Miles " " "
Year first laid.
Maximum grade of pavement.
Guaranteed period, years.
Maximum cost per square yard in 1898.
Minimum " " " " " "
Explain fully the items included in the price per square yard as given
Average " " " " " "
    Foot notes:
    in each case.
Explain fully the conditions of traffic to which each class of pavement has been subjected, such as heavy, medium, light, and the satisfaction each has given in wear, with reasons.
Give extremes of temperature during year.

CONSTRUCTION DATA.

I. SHEET ASPHALT.

1. Kinds of asphalt laid.
    a. Number of square yards of each kind of asphalt now laid.
    b. Number of miles of each kind of asphalt now laid.
    c. Name kinds of asphalt admitted by the specifications now in force.

2. Foundation.
    - a. Character—sand, gravel, concrete, etc. If concrete, give proportions of various ingredients.
    - b. Thickness, inches.
3. Asphalt surface.
    - a. Total thickness, inches.
    - b. Is cushion or binder coat used.
    - c. Thickness of same, inches.
    - d. " " wearing surface, inches.

II. BLOCK ASPHALT.

1. Size of block.
2. Foundation.
    - a. Character—gravel, macadem, concrete, etc. If concrete, give proportions of various ingredients.
    - b. Thickness, inches.
3. Cushion.
    - a. Material.
    - b. Thickness, inches.
    - c. Material used for filler.

III. BRICK.

1. Size principally used.
2. Single or double course used.
3. Foundation.
    - a. Character—gravel, macadam, etc. If concrete, give proportions of various ingredients.
    - b. Thickness, inches.
4. Cushion.
    - a. Material.
    - b. Thickness, inches.
5. Filler.
    - a. Material.
    - b. Merits and faults of each kind used.

IV. WOOD.

1. Blocks.
    - a. Kinds.
    - b. Size.
2. Foundation.
    - a. Character—macadam, plank gravel, etc. If concrete, give proportions of various ingredients.
    - b. Thickness, inches.

4. Cushion.
    a. Material.
    b. Thickness, inches.
4. Filler.
    a. Material.

V. GRANITE.

1. Blocks.
    a. Kind of granite.
    b. Size of blocks.
2. Foundation.
    a. Character—macadam, gravel, etc. If concrete, give proportions of the various ingredients.
    b. Thickness.
3. Cushion.
    a. Material.
    b. Thickness, inches.
4. Filler.
    a. Material.

VI. MISCELLANEOUS PAVEMENTS.

1. Description.
2. Foundation.
    a. Material. If concrete, give proportions of various ingredients.
    b. Thickness, inches.
3. Details of cushion and filler if used, and other points of construction.

PRICES FOR MATERIAL AND LABOR.

1. Give market prices of the following construction materials delivered on the work, or of such of them as are used in paving work.
    a. Broken stone for concrete, per cubic yard.
    b. " " " macadam, " " "
    c. Sand, per cubic yard.
    d. Gravel, per cubic yard.
    e. Cement, per barrel, natural.
    f. " " " Portland—
        Imported.
        American.
    g. Filler, other than sand, per square yard of pavement.
    h. Curbing, per lineal foot—
        Material.
        Setting.

i. Excavation and removal of material to make place for pavement—
Per cubic yard.
Average per lineal foot of street.

2. Give prices paid for the following kinds of labor:
   - a. Common labor, per day.
   - b. Foreman, per day.
   - c. Man and team, per day.
   - d. Concrete mixers, per day.
   - e. Pavers, per day.
   - f. Length of working day, hours.

FINANCIAL STATISTICS.

1. Total amount expended for pavements in 18——.

2. Total amount of outstanding indebtedness for pavements—
City debt.
Property owners' debt.

3. Proportion of cost paid by city.
" " " " " property owners.

4. Explain briefly the method of assessment, by frontage or area of contiguous property, etc. Does non-contiguous property pay portion of cost? If so, what per cent.?

5. Explain briefly method of paying assessment, cash yearly installments, etc.

6. Bonds issued to anticipate installments.
Length of time they run.
Amounts in which issued.
Interest, per cent. per annum.
Are bonds a general city charge, or are they a lien on the property assessed?

Detail table of streets constructed. One for each kind of pavement.

Heads of columns as follows:

Location.
Authority for construction,
Contract and contractor.
Length.
Width.
Area, square yards, including wings and intersections.
Length of curb.
Other items of materials and labor.

Cost—
  Excavation.
  Foundation.
  Wearing surface.
  Curb.
  Other items.
  Total.
Cost per square yard—
  Total.
  Excluding excavation.
  Excluding excavation and curb.

PROPOSED FORM FOR SEWER REPORTS.

GENERAL STATISTICS.

System in use: Separate or combined:

Method of disposal of sewage.

Interceptors?

Sewage allowance per capita.

Storm water formula or rule, with reasons for any modifications.

Discharge formula?

Special local features affecting system.

Guarantee period under contract.

Location of sewer in street; center; sidewalks; single or double line for street, etc.

Rule for depth.

"Y"or Tee branches used or not; if so, on what sewers; if not, manner of making house connections.

Difficulties of maintenance encountered.

Flushing methods.

Have sewers ever been overtaxed? If so, particulars.

Is sewage pumped? If so, by centrifugal or plunger pumps.

CONSTRUCTION DATA.

Amount of pipe sewers in use at beginning of year.

Amount of other sewers in use at beginning of year.

Amount of each laid during the year.

Amount of each at end of year.

Sizes and forms used, circular, egg-shaped, pipe, etc.

Lining material.

Average amount of each size built per day.

Character of excavation: average and extremes.

Foundation used, if any.

Special constructions.

Concrete, methods of mixing and placing.

Method of consolidating trench back filling.

LABOR AND MATERIALS.

Cost of materials, cement, sand, brick, gravel, broken stone, pipe, each size, etc.

Cost of labor per hour, different classes.

Cost of wagons and carts per hour.

Cost of foremen.

Cost of superintendence.

Cost of excavation, per cubic yard.

Cost of sewer pipe.

FINANCIAL DATA.

Total amount expended during year for sewers.

Total amount expended to date for sewers.

Manner of raising money expended.

Total amount of outstanding indebtedness, city's portion, property owner's portion.

Proportion of cost paid by city and property-owners.

Method of assessment, by frontage or area of contiguous property.

If non-contiguous property pays any portion of cost, manner and amount.

Methods of paying assessments.

Bond issue, if any, period, amounts, interest, redeemable; whether general city charge or lien on property assessed.

The Committee on Municipal Data has been reappointed by the President and now desires full discussion and criticism of the forms *as soon as possible* that they may be perfected for presentation to the society at its next meeting. Please send your comments and suggested changes to:

Charles Carroll Brown, Chairman, Bloomington, Ill.
Lansing H. Beach, Capt. Engrs., Washington, D. C.
Almon D. Thompson, City Engineer, Peoria, Ill.

THE PRESIDENT: Are there any questions to be asked in regard to this subject? I will state that the Chairman of this committee wrote to me some time ago, as President of the society, asking whether the committee would be justified in going to the expense of having the schedules printed, so that all the members of the society could see them and more readily understand just what their recommendation was. The letter came at a time when our finances were pretty low, and I wrote him that I hardly felt like taking the responsibility of authorizing any additional outlay at that time. So, while the schedules are printed, the members have not had the benefit of them to look over.

MR. BROWN: I move that the matter be referred to the Executive Committee, with power to present it at a subsequent meeting.

MR. MCLAUGHLIN: I would suggest an amendment to that motion, to refer it to the Executive Committee with power to act in case they find they have sufficient funds.

THE PRESIDENT: It might be referred to the new Executive Committee to carry out the suggestions as far as practicable.

MR. BROWN: I intended to have it referred to the new Executive Committee. That would give them a year in which to give the matter attention.

MR. LEWIS: If these forms should prove to be adaptable to most officers in making their reports, it would certainly be desirable to begin the use of them as soon as possible; and if they prove to be feasible, as I have no doubt they will, I think it would be very desirable if they could be put into the hands of the members of the association in order that they might take advantage of them in the reports which will be forthcoming the next few months, and it seems to me the amendment suggested is in the right line. I second the amendment.

THE PRESIDENT: Let us understand the proposition. As the chair understands, it is to refer it to the new Executive Committee with power.

MR. MCLAUGHLIN: That was my idea: to refer this whole matter to the Executive Committee, and if in their judgment it was advisable for them to go ahead with it, refer it to them with power.

MR. BROWN: I think that the reference of it to the Executive Committee is the proper thing to do. I should like to add to the motion that the Executive Committee be empowered to fill up the blanks which are necessary in their reports, which are suggested by the committee; that is, on electric lighting, street cleaning, and so forth. I would also suggest that Mr. Meyer, of The Engineering Record, says he would be willing to print the schedules in his magazine, and that they could be ready very shortly for distribution to the members. (Applause.)

MR. ANDREWS: I move that the Chairman of the Committee on Municipal Data be added to the Executive Committee for consideration of that matter.

The motion was agreed to.

The motion to refer to the Executive Committee was agreed to.

MR. O'BRIEN: Before we adjourn I should like to ask whether anything has been done about the paper of Dr. Hess with regard to street cleaning.

THE PRESIDENT: Nothing further than the discussion.

MR. O'BRIEN: I should like to ask, for my own information, if anybody in the convention has any method or plan for cleaning asphalt streets, or if there has been any machinery invented within the last year that would do it more cheaply or better than by hand sweeping. I should like to ask that question for my own information.

CAPTAIN BEACH: Until the past year Washington used the contract system entirely. No other system was permissible under the manner in which the appropriations were made by Congress for the purpose. The apropriations distinctly stated that the amount of money set aside for street cleaning was set aside for street cleaning under contract. Also, the law under which the present form of government was organized stated that any work in excess of a thousand dollars must be done by contract. So that, until the past year, all the street cleaning had to be done by contract. That was let out, contracts being made for various periods, sometimes two years and sometimes for five years. During the past session of Congress, however, permission was obtained to clean a portion of the streets experimentally by hired labor by hand. That has proved very satisfactory, the cost to the city being, I am informed by the Superintendent of Street Cleaning, a trifle over half what is paid for the same service by contract.

Thereupon the convention adjourned until Friday at 9:30 a. m.

REPORT OF THE COMMITTEE ON COATING OF CAST IRON AND STEEL RIVETED PIPES.

BY L. W. RUNDLETT, CITY ENGINEER, ST. PAUL, MINN., CHAIRMAN.

When we consider the large amount of cast iron and steel pipe that has been laid and is still being laid in the cities and towns of the United States for the purpose of furnishing water to the inhabitants of said cities and towns, the immense amount of money maintained in these conduits, buried as they are under the ground out of sight, and not accessible for regular inspection, we are at once confronted with the great importance of making these pipes as durable as possible by protection from the rust, and taking every precaution to prevent their capacities being reduced either by chemical action or the adhesion of foreign substances. The cost of the coating is so small in comparison with the total cost of the pipe laid in the ground, and the beneficial effect of the coating is so great, both as increasing the durability and efficiency of the pipe, that the greatest care should be taken in selecting the best material and applying it under careful inspection, watching carefully every detail of the work, particularly in the case of wrought iron and steel pipes, where experience has shown that deterioration is very rapid without a coating, and that the longevity of the pipe depends almost entirely on the kind of coating used and the skill with which it is applied.

The subject of pipe coating was so thoroughly taken up by the committee having that subject in charge last year, that your present committee find it very difficult to get any definite information that will be of any particular interest to the association. It was the opinion of the committee at that time, and is also the opinion of the present committee, after considerable correspondence on the subject, that entirely too little attention is paid to the coating of cast iron pipes.

I think, however, as a result of last year's work, the matter has been more particularly called to the attention of engineers and superintendents, and that where contracts for pipe have required proper inspection in this particular, better work has been done. A casual examination of a large amount of pipe for the City of Chicago showed some very excellent results, and some correspondence with the principal inspecting bureaus for this class of work also shows that they realize the importance of careful attention to the material used and the proper application. By the courtesy of one of these bureaus the committee has received analyses of some of the materials used, but I must confess that to an uninitiated mind the results do not contain much information and do not form an intelligent basis for any special requirements in specifications. We think that if the suggestions of last year, relative to the quality and application of the coal tar products, are carried out, the results will be satisfactory.

In regard to steel pipe, your committee has corresponded with nearly all the places where steel pipe has been laid that were mentioned in the last report, but have been able to obtain very little information as to the results of a year's test on various pipes laid at that time.

Mr. E. Kuichling, of Rochester, N. Y., to whom we were indebted last year for much valuable information, writes as follows: "As to further experience with pipe coatings, I have little further to add, except that a quite recent examination of the interior of our new conduit at a locality where 36" cast iron and 38" steel pipe, coated with Sabin's japan, could be conveniently compared, showed that the coal tar pitch coating of the cast-iron pipe exhibited numerous tubercules of relatively large size, while the steel pipe was practically as clear from corrosion as when first laid. Both of these pipes were laid and put into service in October, 1894, and have been used continuously up to the date of said examination, about ten days ago. The two kinds of pipe are parts of the same lining. A striking peculiarity was the development of extensive organic growths on the interior of the cast iron pipe, while little matter of this kind was found in the steel pipe. It should, however, be noted that the cast iron pipe began at the storage reservoir, and had a length of about 1,000 feet before the steel pipe was reached; it is therefore possible that the organic growths mentioned might have attached themselves equally well to the steel pipe coating, if the latter had been nearest to the source of supply, and thus had first opportunity to obtain the necessary air and food conveyed by the water."

Mr. D. C. Clarke, Assistant Engineer and Superintendent of the Portland, Oregon, works, in reply to inquiries as to how the pipe coating was standing in that city, writes as follows: "The asphalt coating we have used has shown signs of failure in places, but the cause of such failure has not been satisfactorily determined as yet. I enclose herewith a sample of the coating, about one inch square, which was taken from the inside of one of our mains about six months ago. The material seems to be tough and of good quality, but for some reason it failed to adhere to the steel in places as it should have done, possibly through failure to maintain the bath at the proper temperature or to heat the metal thoroughly before removal from the bath. I know of nothing in the way of an asphalt bath better than that which would be obtained by a strict compliance with the letter of the specifications sent you in September, 1897."

We learn, through Mr. Sabin, from an able authority who is giving a good deal of attention to the proper coating of pipe used in large war vessels to convey water over the ships for fire and other purposes, that experiments with the Sabin process have been very successful, and that a plant for coating the pipes with the Sabin method has been erected in Brooklyn navy yard by the Boston Electroduct Company.

In other instances where pipe had been laid no special examination seems to have been made, and it seems to have been the opinion of those in charge of the various works that as long as nothing had happened of such a nature as to call for investigation, that it was well to let good enough alone; so we can draw the general conclusion that thus far the different pipes have been satisfactory.

It would appear to your committee that in the coating of steel pipes the question as to what coating is the best is still unsolved, and that no general rule can be given, but what may prove the best under certain local conditions may not prove as efficient under other conditions. Changes in temperature may necessitate some changes in the compound, but above all it would appear that the pipe should be thoroughly cleaned before any application is put on, and it is only by careful and intelligent consideration of all these little details that the best result can be obtained. In these days of close competition, where there is a tendency to cut the edges as closely as possible, it is particularly necessary to inspect with the greatest care to secure the best results.

It has been unfortunate that the Committee on Pipe Coating has been so widely separated that we have not been able to have any discussion on the subject. It was my intention that we should meet in Washington and form a report there, but almost at the last moment I find I shall be unable to attend the convention.

I send this brief report to bring the subject before the convention, hoping that the other members of the committee may be better prepared, and the members of the association who have had such work in hand may present something as to the results of their experience that may be of interest and profit.

THE PRESIDENT: The report of Mr. Rundlett is open for discussion if any members desire to ask questions or desire to start any discussion in reference to it.

MR. HEWSON: Mr. President and Gentlemen of the Convention: This is a subject that is well worthy of more attention than has heretofore been given to it by engineers and other scientific men. Mr. Lewis, of Brooklyn, struck the key-note in saying that the many failures of these coatings is due to the use of cheap material and methods. That is true. Many of these steel pipes are coated by contractors who supply the pipe. They buy cheap material without proper regard to intrinsic value, wearing or protecting qualities, looking only to price. There are coatings made in our country which have been proven by tests to possess the necessary qualities to afford the needed protection. The higher cost of material and method of application seem to be the chief objection against their general use. Durability and protecting qualities have not yet received that attention from engineers and pipe manufacturers that they should receive. It is idle to expect to fully protect pipes from the destructive action of earth salts and moisture by an artificial coating on iron or steel pipes before every incrustation of rust and sand is removed. The coating must have the natural metal to adhere to and penetrate as far as possible. Then, if care is taken in giving it a proper bath at the proper degree of heat, good results can be obtained. From long experience I know that no material of this nature that is applied cold or dried by a cold bath, or a sun or air drying coating only, has the tenacity and strength which is secured by a proper degree of heat applied to it to aid in its drying. By heat baking only can you secure the required tenacity and hardness of the coating. This question is being agitated and taken up by manufacturers of railroad bridge iron and engineers of the large railway companies. Experiments are going on, and the consensus of opinion of some of the leading engineers and chemists of the various railroads is that the time is coming when, notwithstanding the increased cost, the iron work of bridges will have to be treated by some improved process by which coatings will be placed on the iron or steel by heat. And although the first cost will be increased, the durability and protecting qualities will also be very largely increased.

MR. HOECH: Mr. President, I do not know that I can say anything new to the members of the convention on this subject; but when I was in California last summer the chief engineer of an irrigation company showed me his pipes coated with tar in such a way that I should like to have it brought to the attention of every engineer. He adds sulphur to the tar—I do not know in what amount—and he claims that there is a chemical action of this sulphur-tar on the surface of the iron. He showed me a piece of pipe which was treated in that way, and afterwards the coating was scraped off with a knife; but after this mechanical removal of the tar there yet remained a layer on the surface of the iron, and this layer not removed by the knife was sufficient to protect the iron against the action of some acid which Mr. Newman, the gentleman to whom I refer, applied to it. The pipe was immersed in this acid for twenty-four hours, and it came out just as it was put in, no action being shown. Mr. Newman told me that a manufacturer in Los Angeles had taken up this process and was using it in the manufacture of his pipes. I should like to see some further test made with this; perhaps it will explain the durability of iron in cement. You know that when you put iron in Portland cement it does not matter whether the iron is rusted or not. It is even better if some rust is on the iron, because the Portland cement, in setting, takes up the iron rust, and it seems to be of assistance in the setting of the cement when rust is present. Perhaps the rust or scale of the iron will take up the sulphur in tar in a similar way.

MR. BENZENBERG: Before closing the discussion on this subject it may be of interest to say that in the specifications for cast iron water pipes for the City of Milwaukee last spring I specified the coating recommended by the committee upon this subject at the last convention. Having been Chairman of that committee, I had some faith in what it recommended after the investigations which were made. After specifying the composition of the coating, the specifications required a thorough cleansing of the pipe before it became cold, the immersion of the pipe for a given number of minutes, removal long enough to let it drain, and then a re-immersion. Previous to the receiving of the bids the various contractors for furnishing the cast iron pipe objected to the new coating specified, claiming that they were not familiar with the coating, nor with the extra amount of handling that would be necessary, nor the extra provisions that would have to be made for the baths, and that they would have to add to the price for that reason. They were informed that if it were necessary to add that price they could do so, but that we wanted special attention given to the coating, as much attention as was given to the casting of the pipe, and that the inspectors would be instructed to rigidly enforce the specifications. I do not know that they have added anything to the price. The pipe went exceedingly cheap and on close competition. The contractors who secured the work, after having coated the pipe according to the new specifications, were more than pleased with the results, and were ready to apply that coating to any and all of the pipes, and to dip the pipe twice, whether specified or not by other cities, because they were satisfied the results were so far superior to those obtained heretofore, namely, a uniform and thorough coating which was tenacious at any and all temperatures. The difficulty which had arisen heretofore in the coating of pipes seemed to have been entirely overcome; that is, the formation of small air bubbles, or the drawing off, with the draining of the varnish, of the sand or dust which had remained upon the face of the pipes, which left, after the draining was completed, exposed surfaces of the iron subject to the action of the water. The coating has been very satisfactory and it will be continued in Milwaukee.

The President: If there is no further discussion upon this subject, the next subject for consideration is that of electrolysis, and I am sure that all our cities are especially interested in that subject. Of course, the action proceeds underground. It is not anything that can be seen and known about until in some cases officials learn to their sorrow that their water pipes are very materially damaged. I am very glad to have the Chairman of the committee, who has given a great deal of study to that subject, here to present it to the convention. I take pleasure in introducing Mr. Harold P. Brown, who will present a paper on "Electrolysis Tests at Dayton, Ohio."

ELECTROLYSIS OF CAST IRON PIPES AT DAYTON. OHIO.

BY HAROLD P. BROWN.

The injury of water pipes by electrolysis is at present so well understood that my only excuse for again calling your attention to the subject is found in the peculiar and unusual conditions disclosed at Dayton, Ohio, in an examination made last July.

All of us know that electrolysis may be expected to injure lead and wrought iron pipes on the lines of electric roads within a radius of half a mile from the power house, but we have believed that cast iron mains were safe.

Our faith has been rudely shaken by the condition of these pipes at Dayton. They appeared to be entirely uninjured and the black paint seemed to be unaffected. But on scraping the pipe with a knife, the metal was found so soft that grooves could be cut into it. Therefore, sections were removed for mechanical and chemical tests, and the results fully justify your most careful attention, since your own pipes may perhaps be in a similar condition.

Dayton is a beautiful city with a population of about ninety thousand. Its streets are remarkably well paved with granite blocks and asphalt, having foundations of unusual thickness and solidity. The large number of modern sky-scraper office buildings and handsome stores in the business portion give it quite a metropolitan appearance. It has fully eighty miles of electric roads and over two hundred and twenty-five cars.

Electrically considered, it is cut into four parts by the Stillwater and Mad Rivers, which unite to form the Great Miami, and by Wolf Creek, meeting the Miami two miles or so below.

Three of these parts are further subdivided by canals. The business portion of the city is thus practically located upon an island, and the electric current used by the street cars must follow the rails across bridges or pass on the pipes under the river to get back to the power house.

Practically, ninety per cent. of the entire current from the business portion of the city crosses the river on one 12-inch and one 10-inch water pipe, one 8-inch gas pipe and one 10-inch natural gas pipe.

The two main power houses are about ¼ mile apart on the west side of the Miami River. A third but smaller power house is on the east side of the river, but quite a distance south of the business portion of the city. Two other roads have their terminals in Dayton, but thei power houses are elsewhere.

Following my ordinary methods, a switchboard was mounted on wagon and provided with a complete set of Weston electrical instruments reading from one ten-thousandth part of a volt per degree up to 75 volts, and from ½ an ampere to 150 amperes.

At each hydrant along the electric roads of the city a reading was taken from the trolley wire to each of the four rails; from the trolley wire to the pipe and from the pipe to each of the rails. These measurements were made in sets of three in such a manner that any poor contac or any defective condition of the testing apparatus was at once indicated and corrected. The instruments had recently been compared with standards and were known to be correct. Over twenty-five hundred electrical measurements were made, and the results of the readings were plotted out upon a map of the city. On this map the measurements in the danger district, where pipes are positive to the rails, are marked in red, and where uninjured in green ink.

Fifteen excavations were made, and the measurements repeated on the pipes themselves. These excavations are marked on the map with a cross, either red or green as the pipes were found injured or uninjured. A careful examination was then made of the physical condition of the pipes by J. H. Shaffer, metallurgist and chemical analyses were made of samples of soil and the metals of the pipes and incrustations upon them. These were made by E. E. Brownell, E. E. and Jas. O. Handy, chief chemist.

These electrical tests showed that the pipes in the business portion of the city, 1½ to 2 miles from the power houses, were positive to the rails, and therefore subject to electric corrosion.

The highest readings in this part of the city were 4½ volts, near Fifth street bridge and near Washington street bridge.

Near the power house on the west side of the river the pipes were 9 volts positive to the rails, and the danger district extended about ¾ of a mile to the west.

In the southern part of the city the highest positive reading was 2 volts, in front of the Oakwood avenue power house.

In making the electrical tests the time of the reading was noted, since the pressure depends on the amount of load carried at the power house, and will vary correspondingly in all parts of the city. For instance, in front of the power house of the People's Railway on Washington street, at 5 p. m., during the heavy load, the pipes were 9 volts positive to the rails, while at 2 p. m. they were but 6 volts positive.

It was at once evident that the danger district was extremely large, since the entire area marked in red is in such an electrical condition that

AVE

lead and wrought iron pipes would be injured. This was verified by the records of the Water Board, which showed a large number of service pipe renewals. These renewals are very expensive in Dayton, because, as previously stated, the foundations of pavement are unusually heavy and unusually well constructed.

The Board of Water Works very wisely refuses to allow any one to tear up the pavements. When a permit for excavation has been secured, only the trained employes of the paving department are allowed to remove the paving. After the work is completed, no one but these same employes can fill in the hole and replace the pavement. This replacement is so well done that no traces of the excavation are evident.

Unless a remedy for the electrical condition of the pipes is very quickly applied in Dayton, it is certain that a large amount of excavating, replacing of pipes and paving will need to be done. Cast iron pipe is usually little affected by electrolysis, since the coating of adherent moulding sand and tar paint protects it.

In the ordinary soil, an iron pipe submitted to electrolytic corrosion is covered with a layer of iron oxide, which is a poor conductor of electricity, so that, with a given pressure, the deeper is the layer of rust and the slower the rate of corrosion.

But, to my surprise, the soil surrounding pipes in Dayton gives an entirely different reaction when a current passes through it. The tar seems to be no protection whatever, and the surface of the pipe in the danger district is changed into a soft black material resembling graphite and easily cut with knife.

This material is such an excellent conductor that, instead of checking, it tends to increase the action by reducing the resistance of the path through which the current must flow in order to reach the rail. Moreover, the stones and pebbles near the pipes are actually electro-plated with the metal of the pipes, whether iron or lead, as can be seen from the samples exhibited.

This condition I had never before seen, and as far as I know has not been prevciously reported. Since my Dayton report was published, I have received a letter from Mr. Dabney H. Maury, Jr., Superintendent of the Peoria Water Co., Peoria, Ill., in which he states that he has encountered the same phenomena.

In order to electrically deposit a layer of metal two things are necessary: first, a liquid which will dissolve the metal, and, second, an electrical current exceeding 0.01 of a volt in pressure, flowing away from the metal through the liquid.

The fact that the pebbles are electro-plated showed that both these conditions exist, but in order to prove conclusively that the soil itself did not injure the pipes, a pipe surrounded by the same soil was uncovered in another portion of the city where there was absolutely no trace of an electrical current.

This pipe was on Logan street, near the canal; the records showed that it was put down in 1874, while the pipe taken out at the west end of Fifth street bridge had been in use ten years and exposed to electrolysis for four years.

If the damage was caused by the soil itself, this pipe would, of course, have been in a worse condition than the Fifth street pipe. But the Logan street pipe was apparently as good as new.

To make the comparison absolutely beyond criticism, a section of each pipe was taken out, chemically analyzed and mechanically tested. The chemical analyses of the iron pipes were nearly identical, and are as follows:

	Logan Street Pipe.		Fifth Street Pipe.	
Phosphorous	.789%		.800%	
Sulphur,	.073%		.057%	
Silicon	2.270%		2.500%	
Iron	not det.		not det.	
Carbon combined	.13%	3.56%	.24%	3.12%
Carbon graphitic	3.43%		2.88%	

The samples of the incrustation of the Fifth street pipe analyzed as follows:

Phosphorous	1.821%
Sulphur	none
Silicon	not det.
Iron	33.43%
Carbon combined and carbon graphitic	7.12%

This analysis showed that the percentage of iron was greatly diminished, while the percentage of carbon was more than doubled; careful investigation showed that the carbon was merely the amount originally in the pipe, the carbon being left, while a large portion of the iron had been carried away.

The chemical analyses of the soil showed that the solvent was produced electrically from carbonate of sodium and chloride of sodium in the soil. Neither of these by itself in the small proportion shown by the analysis (less than 1%) would injure a cast iron pipe covered with tar, though, as is well known, a strong solution of chloride of sodium or common salt will rust wrought iron.

But the presence of even 0.01% reduces the electrical resistance of the iron, and the passage of the current decomposes these salts and forms muriatic or hydrochloric acid, which dissolves the metals. Having thus determined the cause of the trouble, it remained to fix its extent.

Fifteen excavations were made in different parts of the city to determine how much electrical pressure is required to seriously injure the cast iron. A pressure of 3 volts and less is found to cause a graphite coating not exceeding 1-32 of an inch in depth; the iron beneath seems to be uninjured. From 3 to 4½ volts, the thickness of the layer is increased in a ratio depending upon length of time which the pipe has sustained this pressure.

With a knife or file soft spots can be found in a pipe from 1-16 of an inch to ¼ of an inch deep. With higher electrical pressures the extent of the injury is even greater.

In all cases the damage is directly proportional to the pressure and to the length of time during which the current has been flowing; while it is inversely proportional to the distance between the rails and pipes.

By reference to the electrical pressures indicated on the map accompanying my report, one can approximately determine the number of feet of water mains affected. In my opinion, all mains and service pipes in Dayton are seriously injured where submitted to 3 volts pressure or more for 2 or more years when within 4 feet of the rails. This would mean less than one mile of mains, but with lead or wrought iron service pipes the pressure limit should be as low as 1 volt. Mr. Chas. E. Rowe, Secretary of the Water Works, however, feels that 17,513 feet of mains should be replaced at a cost of seventy-seven thousand dollars.

To determine what percentage of mechanical injury had been sustained by the pipes, it was intended to compare the hydrostatic pressures required to rupture the Logan street and the Fifth street pipes, but defects in the apparatus employed prevented a fair test.

The Fifth street pipe at 150 pounds pressure leaked through the corroded spots, while the other pipe was able to stand 300 pounds pressure. Test bars were cut from the best portion of both pipes and broken on a Riehle testing machine.

The average transverse strength of the Logan street pipe was 1,800 pounds per square inch, as against 1,085 pounds to the other. The tensile strengths were respectively 16,000 and 11,425 pounds, and the deflections were 0.25 and 0.20 of an inch.

Four years of electrolysis had robbed the Fifth street pipe of about 30% of its transverse strength and about 45% of its tensile strength, and had caused it to leak at 150 pounds pressure.

Since I wished to avoid any suspicion of unfairness, I asked the managers of each of the three leading roads to allow their experts to accompany me and to check my instruments, methods and readings. This was cheerfully done, and I received from these gentlemen full information concerning their plants and electrical connections, as well as every possible courtesy during my examination.

The rail joints on several lines of road had recently been removed, the rail ends brightened with the sand blast, and the "cast-weld" joint applied. This was done by the railways with an idea that it would reduce electrolysis as well as make a fine mechanical joint. It was a success individual joints and by electrical measurements of several stretches of mechanically, but was an electrical failure, as was shown by tests of 1,000 to 1,200 feet of each of the four rails and of the pipes below them.

The measurements were compared with others made last February on same rails before the "weld" was applied, when very small bond wires were used on the rails. There was practically no variation in the results, as would have been the case had the "weld" possessed high electrical conductivity.

I found that two of the rails were carrying no current whatever while the other two carried but one-twentieth of the amount of current on the pipes below them. And yet, some men will tell you that a "weld" can be made by pouring 60 or 70 pounds of molten iron around 40 or 50 pounds of cold steel rails buried in moist earth. I feel confident that if the railroads would unite in the expenditure of five to seven thousand dollars for the proper electrical apparatus and connections, all the water pipes in Dayton could be maintained negative to the rails.

Then the pipes would harden, as is the case with the section pipe, which I brought to show you. Moreover, any further electrolysis that might occur would be in the opposite direction and would therefore add a layer of metal to the pipes instead of injuring them.

I will not here enter into discussion of the electrical methods required in Dayton to obtain this result, but it is evident that no plan heretofore suggested for electrolysis prevention will effect a cure there, owing to the unusual conductivity of the soil and the peculiar division of the city.

But I would like to offer a few comments and four or five practical suggestions. Do not imagine because your pipes are not leaking and bursting, that they are safe from electrolysis. If the electrical conditions are against them, they are getting weaker day by day. On the other hand, do not antagonize the railway companies the moment that the subject of electrolysis comes up in your city. They are not intentionally injuring your property and if a friendly talk is had and a joint investigation is made, you are likely to get the speediest and most satisfactory action.

The railway manager is as much interested in stopping the trouble as you are; every pound of metal taken from your pipes means to him a heavy loss of power, increased investment for engines, boilers, dynamos and conductors. And if it is finally established by legal decisions that his current has injured your property he will have to settle the bill.

The best course for all concerned, it seems to me, is to take mutual action while the bill is small and not wait until a bursting main during a fire spreads the loss over the entire community. The usual procedure brings a dead lock.

The water works people discover signs of electrolysis and at once pounce upon the railway managers. These either refuse to believe that they are responsible for the trouble and thus bring upon themselves a shower of threats, or they say that, although they cannot admit the fault is theirs, they are nevertheless willing, rather than earn the ill will of the public, to do anything in reason if the others will only tell them what to do.

Then the others suspect some cunningly hidden legal trap and decline to give any directions whatever. And so nothing is done.

There seems to be an idea prevalent that if the Water Board suggests to the railway any scheme for stopping the trouble and the scheme is then tried and fails, the railway is thereby freed from all future responsibility.

How anyone can believe that the mere following out of a plan of experiment would cancel indebtedness is beyond my understanding. It is giving a legal tender value to the acceptance of a suggestion, which seeems to have no basis in fact, in equity, nor in law. But this idea has cropped out in so many cities that I hesitate about offering the following practical suggestions:

1. It will not be a mistake to follow Dayton's example and obtain complete and accurate information concerning the electrical, chemical and mechanical condition of your pipes, especially in the vicinity of the power house.

The trouble may be confined entirely to the lead in the service pipes and in the calking of joints on your mains; but even here serious damage may result if the matter is neglected for years.

2. Do not put down any more lead or wrought iron service pipes, as these are the first victims of electrolysis, and their replacing means ruin to pavements. Use instead wooden pipe, banded with a close spiral of hoop iron and covered heavily with asphaltum.

This will stand the heaviest pressure in use and is not affected by electrolysis since the hoop iron is low in conductivity and is not electrically connected at the joints.

Its cost is said to be reasonable and it has a successful record of many years' service.

3. Use the same kind of pipe for new mains in any district in which a railway power house is likely to be erected and heavily paint the lead calking of cast iron mains, using asphalt or petroleum wax.

4. In the danger district along the lines of electric roads and on intersecting streets, put into your water and gas mains two or more consecutive lengths of these wooden pipes, so as to break the electrical continuity of the mains and thus make their resistance greater than that of the rails. Fill in the space around them with broken stone and connect with drain if possible.

5. Midway between the wooden sections on each main, attach insulated pilot wires, leading to a central office. Connect similar wires to the rails nearest the pipe and make daily electrical tests at times of heavy load. If any section shows positive to the rails, cut it at once into smaller sections and call upon the railway to rebond its line upon that street.

This, with the proper electrical management of the railway feeder wires and apparatus, will effectively protect your mains.

The President: The discussion of this interesting paper is now in order.

Mr. Holman: Mr. President, we have had some little experience with this subject in St. Louis. If a section of this pipe which has been affected by electrolysis is examined under the microscope it will be found that the metallic iron is removed from the pipe, leaving a skeleton structure of carbon and the dross and dirt that is naturally in with the iron. The outer edge of the iron, when seen under the microscope, is very much like a forest at a distance, jagged, looking like trees. This process goes on until the metallic iron has been completely dissolved out of the pipe. The damage takes place, of course, where the current leaves the pipe, or where there is a skip in the pipe over a joint. Now, the remedy which will stop this destruction of municipal property, or the property of the people, and the remedy which we have suggested in St. Louis without any hesitation whatever on legal grounds, is simply to suggest to the railroad companies that they do not own the earth and the fullness thereof; that they have no right to destroy public property, and that they must keep their currents to themselves by providing, first, the proper returning circuits, and seeing that their wires are properly connected to them. It requires even more capacity in copper for return feeders than it does for the outgoing current.

That is the only complete solution of the electrolysis problem. The other suggestions are simply negative. They palliate. They defer to the railroad company and to the corporation. But, as I say, the only complete solution of the problem is simply to insist that the railroad companies bear the entire expense of conducting their business and stop destroying the property of the public. (Applause.)

MR. HAROLD P. BROWN: Mr. President, unfortunately the establishment of a copper line underground in conditions similar to those which exist in Dayton would not have the effect of completely checking the trouble. Where the soil is an excellent conductor and you have to compete with that soil you must do more than offer a return circuit of copper upon which the current may travel. To give you an idea of the conductivity of the rails themselves if they are properly bonded, each ninety pound rail would be equal to about one and a half square inches of copper. That would mean for four rails on a track, four times that amount, which is very largely in excess of the usual outgoing feeder for the trolley wires. The point is this, without entering into technicalities, that the rails are connected with the moist earth for miles and miles of surface. That moist earth is an excellent conductor. If it happens to be dry gravel, then the suggestion made by the gentleman from St. Louis will entirely prevent this trouble, because the water will leave the rails and leave an open circuit between the rails and the pipes; but where you are unfortunate enough to have a soil which will act as an electrical conductor, this soil and your water pipes forming a network under the rails, offer a conducting path far in excess of anything offered by the return rail or any amount of copper conductors which they can afford to put in. They will thus share the current inversely in proportion to their resistances. Now, you can treat your pipes so as to make them of less conductivity, but you can hardly compete with the earth in certain localities as a conductor. I do not know whether I make myself clear, but by breaking your network of pipes at intervals and putting in, say ten or twenty feet of non-conducting pipe and draining that portion by suitable copper conductors, you can make the electrical resistance in the pipe circuit greater than the resistance of the real return, and therefore the greater portion of the current will return on the rails and on the rail return feeders.

Newark has very heavy copper cables connected to the water mains near the large power house, but the pipes are, nevertheless, 3 volts positive to the rails at time of heavy load. Two years ago my directions were followed in operating the power house and the pipes were kept negative to the rails. I do not believe in the policy of carrying heavy electrical loads upon the pipes as the resistance encountered at the points will eventually cause trouble.

MR. HOLMAN: In cases of that kind why should the public spend their money to protect their pipes? The City of Cincinnati has solved that problem completely. The City of Washington has solved it. They simply make the railroad company use metallic circuits throughout, and not use the rail as a partial return. The underground trolley system used in Washington is a fine example of that. The double over-head trolley system in Cincinnati is also a good example. As I say, and as I insist, the solution is to make the railroad companies keep their currents off of the pipes, by one means or another, even if it is necessary for them to put in a double over-head trolley or an underground metallic circuit to keep their electricity at home.

MR. HAROLD P. BROWN: I quite agree with the idea that the railway should stand the expense; but in regard to Cincinnati, I am aware that the pipes there show that the double trolley is not a complete cure. And right here in Washington I was informed this morning by a gentleman whose card I have—Mr. Burket, and I wonder if he is here—that they have electrolysis of the pipes right here in Washington.

MR. HOLMAN: In New York, on the underground trolley, they hold the difference in potential down below one-tenth of one volt and have no trouble with it, or it can be held down to nothing if the company will put in a feeder of sufficient capacity to properly complete a metallic circuit.

CAPTAIN BEACH: Mr. Allen, the electrical engineer of the District of Columbia, is present here this morning and I think he can explain the conditions existing here and the means taken to prevent electrolysis.

MR. ALLEN: Mr. President, I will not go into details of the conditions found here. They are similar to those in other cities where the single trolley is used, but I will state briefly the means that are being taken to prevent any further damage.

At the last session of Congress there were three or four bills passed, incorporating two new trolley roads and allowing extensions on others, one of those being the extension of an existing cable road which is soon to be changed to an underground trolley system. And the law in that case provides for a double trolley. The company have submitted plans for this extension and intend to put it in, and I doubt if they would go to that expense if they considered the system unsatisfactory. Two other roads were incorporated which have not begun construction yet, and they are required to use the double over-head trolley. One other company operates an experimental underground system in connection with its single trolley road. A portion of its line crosses the bridge over the eastern branch of the Potomac. There they are required to put in a double over-head trolley. They have been operating that section of the line over the bridge by horses. Inside the city, as I suppose most of you are aware, we have no trolley roads, no over-head trolley roads except one portion of the Georgetown line, and at the time that was installed it was not a portion of the city. Inside the old city limits of Washington there is not a foot of single trolley wire. The electric roads are operated on the underground trolley system with complete metallic circuits and from those metallic circuit railroads there is no trouble whatsoever, in all the tests we have made. Bills were prepared at the last session of Congress, and passed through one House, but did not get through the other, requiring the existing trolley roads to use the double trolley, giving them a certain limit of time, I have forgotten whether it was one year or two years, in which to make the change. The conditions are somewhat different here from what we find them in other cities. The double trolley could very easily be operated, there being very few intersecting lines, and where they do intersect intersecting at right angles. So the numerous branches and turnouts which would be necessary in a city where several trolley roads are in operation would be unnecessary here. We have not those conditions, and we are looking to prevent electrolysis by that means, substituting the double over-head trolley for the single on the suburban lines and in the built-up portion of the city requiring the metallic circuit underground trolley system or one very similar to that.

Captain Beach: Mr. President, I was a little bit surprised to hear Mr. Brown state that the double over-head trolley in Cincinnati had not proved entirely successful. There is one feature which is added to the requirements in this city which Mr. Allen has not mentioned and which we hope will secure the desired result, and that is, the law says, that neither pole of any dynamo furnishing power to the road shall be in any manner connected with the earth. We hope that that provision will result in keeping the current supplying the power to the roads entirely out of the ground.

The President: There was also to be a paper presented by Mr. E. W. Boynton, Commissioner of Public Works, of Davenport, Iowa. Has the Chairman of the committee heard from Mr. Boynton in reference to his paper?

Mr. Harold P. Brown: He wrote me last week that he would be here and I expected to meet him here. I have not heard anything from him since.

The President: Apparently neither Mr. Boynton nor his paper are in Washington. The final committee report is that of the Committee on Review, of which ex-President Benzenberg is Chairman, and we shall be glad to hear from Mr. Benzenberg.

Mr. Benzenberg: Before proceeding to read the report I should like to make a few remarks on the subject which is under consideration. I cannot agree with the author of the last paper in his suggestion for the introduction of resistance pipes in the line of the water main. Undoubtedly some of the current that is conducted to the rail of a single trolley system will escape through the earth to some other continuous conductor. The amount of this depends upon the law of conductivity and resistance to the current. If such a current does reach a water pipe—and in many instances it cannot be prevented from doing so except by a double over-head trolley system whereby the current is prevented from reaching the ground at all, or by the underground conduit system if properly constructed—and the pipe affords such ample conductivity that there is no desire on the part of the current to again leave that pipe, and that current is carried directly to the negative pole of the dynamo by a proper conductor, I do not see where the damage is going to occur to the pipes.

MR. HAROLD P. BROWN: At the joint.

MR. BENZENBERG: Not at the joint, because there is not enough resistance there if you have a proper joint. The damage to the pipe is caused by the current leaving the pipe and seeking some other better conductor. Of course it is the proper thing, by one method or another, to prevent the current from reaching the pipe at all, and to compel the railroad company to return the current in its proper channel to the power house; but if it should reach the pipe or the main, it seems to me that the only solution for it is to keep it there instead of putting in resistance that would compel the current to leave the pipe for some other conductor which has less resistance, and thereby create the damage which should be avoided. I do not think the problem is very difficult or a very mysterious one, so long as there is ample conductivity in the pipe line for so much of the current as gets there, always preventing it from getting there if you can.

We have had some experience in Milwaukee in the bursting of mains by electrolysis. It was found that in many instances, without the knowledge of the city authorities, direct connections had been made between the rails and hydrants or pipes for the purpose of making the pipe a return conductor. After carefully considering the matter an ample copper connection between the water main opposite the power house and the dynamo was made, so as to cause as little resistance as possible to the current returning from the pipe to the dynamo. That connection has been in service for over four years and no trouble has been experienced since, although a large part of the current is returned over the mains. I am not advocating that it is desirable to have any of the current return over the water mains, but I merely want to show that it is better after having received the current upon the pipes to provide for its return in the pipes instead of allowing it or causing it to escape by offering resistance anywhere along the line. Our experience has been that it is all right so far. Most accurate measurements have been taken as to the resistance offered in the lead joints, where a large volume of current was being returned through them and no perceptible resistance sufficient to prevent the passing of a large volume of current at a fair potential through the lead joints was found. I thought it might be of interest to state this before taking up the report of the Committee on Review.

Mr. Benzenberg then read the report of the Committee on Review as follows:

To the President and Members of the American Society of Municipal Imrovements:

Gentlemen: The Committee on Review is not supposed to be one which would be lacking material for its report, covering, as its title indicates, a review of all new matters of interest reported upon by municipal officials throughout the country, so far as such reports of various departments are made and are accessible, yet a close examination of all such reports fail to reveal much that is new or novel in either legislation, methods or construction.

There are seemingly two causes for the scarcity of this information in departmental reports, one, naturally, that there is nothing of that nature to report, and, second, that the official for one or all of many reasons has failed to report upon interesting work, confining himself almost exclusively to tabulated statements of such data as the local or general laws require to be made.

Very few reports contain either descriptive information or illustrations of municipal work and improvements, which do so much towards making these documents so valuable and instructive to all readers whether at home or abroad. This is so, undoubtedly, because these reports, when written, are supposed to be made to local constituencies only, and not for general distribution among students of municipal improvements, who are more interested in the progress made in various cities towards the solution of these civic problems, than in the statistical columns submitted, not but what the latter are necessary, but that they are made more interesting and valuable by the addition of explicit and descriptive statements and illustrations.

The committee, therefore, appeals to all the heads of various departments of municipal improvements to enlarge in their annual reports upon any work which has been executed, especially where difficulties were encountered in connection therewith, and also upon any changes in methods, management or legislation which may have been introduced and which relate to public betterments.

In order to obtain the necessary data for this report, a circular letter was sent to 85 leading cities of the Union, clearly setting forth the objects and duties of this committee with a request to the official addressed to kindly co-operate by forwarding a copy of the last annual report or such extracts therefrom as related to any new work, method or legislation during the past years. Replies were received from about one-third of the number addressed, many of them containing much desired information in detail, which will be presented either under the head of new legislation or under that of municipal work.

NEW LEGISLATION.

From the replies and reports received it is apparent that in many states greater facilities for further improvements of streets is granted to municipalities by legislative acts and by amendments thereto, permitting cities to lend their credit for the benefit of individual property holders, by the issue of bonds which are to be repaid by a special tax levied annually against the property directly benefited by such improvements, for a period of from five to sixty years.

In some states the authority of determining the necessity of improving streets under such act is placed in a special board or commission appointed by the Mayor for that purpose.

Mr. E. W. Boynton, of Davenport, writes that in October, 1897, the State of Iowa adopted a new code providing that each city must be divided into not less than three districts and that a tax of five mills on the dollar on all taxable property is to be levied for the purpose of improving streets. He also states that the law permits property to pay for permanent improvements in ten equal annual installments with interest thereon, but that no improvement is assessed against any abutting owner until all of the work is completed, thus doing away with the necessity of any rebate in case the work should cost less than estimated.

Mr. George W. Tillson of Brooklyn transmitted abstracts of certain special laws designed to make the payment of taxes in certain cases of street improvements easy. One act provides for the sale of certificates of indebtedness of the City of Brooklyn to an amount not to exceed $500,000.00, with which to pay for street work when completed, the amounts to be refunded by the property benefited in five equal annual installments.

A similar act was passed to provide funds for the payment of a large amount of grading necessary to bring certain streets in a very rough part of the city to grade. These funds were to be returned by a special annual tax levied upon the property benefited for a period of ten years.

He also reports another and very remarkable law which authorized the issue of five series of bonds of $100,000.00 each to cover the cost of certain street work. These bonds were to be payable in 50 annual installments, the first to become due in not less than ten nor more than eleven years from date of issue, the installments to be paid by a special tax laid annually upon the property benefited. The first tax will not be due until ten years and the last not until sixty years after the street work has been completed.

Mr. A. D. Thompson, City Engineer of Peoria, Illinois, reports in abstract a new law of the State which went into effect July 1st, 1897, applicable to improvements payable wholly or in part by special assessment or special tax. The act creates a special board of five members, with whom all such improvements must originate and provides in detail a slow and cumbrous method of procedure and of serving repeated individual notices upon every property owner interested, as to every step that is taken in the lengthy proceedings of notice, of cost, of assessment, of court hearing, of a possible reassessment and a possible rehearing.

This act requires that upon the award of contract, 75 days after confirmation of the assessment, notice of such award shall be posted for five days and advertised in daily newspapers for at least two days. It also provides that the owners of a majority of the property fronting on such street may within ten days after the award, take and do said work at ten per cent. less than the price at which it was awarded.

This law is reported as being cumbersome, complicated and unsatisfactory.

Mr. A. Rosewater, City Engineer of Omaha, reports: "Under our system the Board of Public Works receives bids for all classes of pavements before the filing of petitions designating the material on the part of the property owners. In this manner brick, stone and the various classes of asphalt are all brought into competition with each other, and the property owners are enabled to act more judiciously than otherwise."

Mr. J. Griggs, Chief Engineer of Columbus, Ohio, reports a law passed by the General Assembly of that State last winter for cleaning, sweeping, sprinkling and repairing streets in cities of the first grade in the second class which contains a new feature. It provides that before any such work is ordered, the Board of Public Works shall appoint in every case for one year two electors, owners of real estate fronting on such street, avenue or alley, who, with the Chief Engineer, shall constitute a board of commissioners for such highway. This board is required within ten days thereafter to file with the Board of Public Works a written statement of the cleaning, sweeping, sprinkling or repairing that is necessary to be done on such highway during the ensuing one year, and thereupon the Board of Public Works is to perpare specifications and let a contract or contracts for such work, the entire cost of which is assessed equally by the foot upon all the land fronting such street between the points named in the contract, excepting, whenever there is a street railway operated on such street, the company so operating shall pay its share of the expense in the proportion which the part of said street occupied by the track of said railway bears to the whole surface of such street, the balance of such cost and expense to be equally assessed upon the property fronting said street.

In the City of Boston the authority to lay out, open and improve highways, is by special act vested in a commission of three able and discreet men, who are appointed by the Mayor. This board has the authority to locate highways and determine the nature of the improvement, kind of pavement, the grades, sizes and material for sewers, catch basins and all connections, and the sizes of water and gas mains and their connections. The cost of such improvements is paid for from funds derived from the sale of city bonds which is repaid with interest to the city by the owners of the several parcels of land benefited according to the number of square feet contained in such parcel of land lying within one hundred and twenty feet of such highway, said repayments to be made entire within ten years.

To pay the expenses incurred in laying out and constructing four avenues projected under the above act a subsequent act was passed directing the City Treasurer of Boston to sell bonds to an amount not exceeding $2,500,000.00.

Another act passed last May authorizes the City of Boston to isssue bonds, notes or script to the amount of $500,000.00 for the purpose of establishing a comprehensive system of playgrounds to meet the wants of the different sections of the city, not exceeding twenty in number. This undoubtedly is the first enactment for such liberal and humane purposes in this country, worthy of being emulated by others.

Boston has also by ordinance established a separate and distinct department of baths placed in charge of a board of seven members, two of whom shall be women. This board is authorized to establish and to have the care and custody of all bath houses, gymnasia and of all urinals or public convenience stations maintained by the city. This seems also a worthy departure which will undoubtedly insure greater attention to this branch of public comfort in a large city like Boston.

MUNICIPAL WORK.

Very little indeed that is either new or novel has been reported in the method of doing or specifying municipal work. Naturally the conditions, the materials used or the magnitude of the work or improvements vary with each city, but the manner in which such work is specified to be done does not generally differ. There are some exceptions, however, as for instance the different foundations for asphalt pavements provided for under the many classifications of the Omaha specifications, which in their variety approach the experimental stage in character. Upon the results of one of these modifications Mr. Rosewater writes that "the repavement of asphalt streets upon broken stone over old concrete where formerly wooden blocks were laid, has been accompanied with good results. The only objectionable feature is the difficulty of securing as smooth surface over broken stone as is secured on concrete. On a mile and one-third length of such pavement laid last year and exposed to 18° F. (below zero) last winter, no cracks have as yet appeared. This pavement had the concrete, adjoining curbs, for a width of nine inches broken and replaced with broken stone connected at inlet for subdrainage."

In his annual report of 1897, Mr. Rosewater assigns three leading causes for the appearance of cracks in asphalt pavements. First, the tendency of concrete to shrink within the first six months. Second, the contraction and expansion of the concrete base incident to extremes of temperature. Third, the upheaving influences of retentive soils containing moisture when exposed to freezing, thereby cracking the concrete and with it the asphalt. He then presents at length, to support the first two propositions, an extract from a paper by G. R. Stracham, A. M. Inst. C. E., read before the Association of Municipal and Sanitary Engineers at Leicester, England, July, 1887. This paper demonstrates the fact that the cracks in the asphalt are due to the cracks in the concrete base and cites many cases where examinations exhibited that fact. It then refers to many experiments that were made with the object of preventing the cracking of the asphalt in cases where the concrete base contracted sufficient to cause cracking, and contains this conclusion: "From this it would appear that the principle of a material between the concrete and the compressed asphalt which will absorb the effects of the movements of the concrete is a correct one, and the writer invites the members of the association to experiment on cheapening the method." Undoubtedly the reason for the absence of cracks in this pavement at Omaha is the fact that this layer of broken stone serves as the medium between the asphalt and the concrete to absorb the movement of the latter when contracting instead of its acting as a layer affording drainage, especially when there is no necessity for drainage in that part of the pavement.

Mr. Thompson, of Peoria, reports that the indications are favorable that the experiment he made of cutting or separating the asphalt to prevent cracking is a success, though but one winter has passed over the work. He separated the asphalt from curb to curb at intervals of 50 feet and of 100 feet by cutting the same to the concrete with an ordinary trowel after the asphalt had been compacted with the hand roller, filling the cuts with dry cement and then compressing the whole with a steam roller.

Capt. Lansing H. Beach, Engineer Commissioner, District of Columbia, presents the following as the practice in the District to prevent formation of cracks in concrete sidewalks. He writes that the use of broken stone in cement sidewalk work has been abandoned, substituting instead gravel entirely, "on account of the greater ease of cutting joints and the consequent better joint with less disturbance of the concrete in the block. The specifications for a concrete sidewalk without frost base provides for a layer of cement concrete four inches in thickness, overlaid with a layer of cement mortar one inch in thickness covered by a thin dry surface coat. Specifications for sidewalk with frost base provide for a layer of medium-sized gravel six inches thick as a bed for the concrete. The cement concrete consists of one volume of Portland cement, two volumes of clean, sharp sand and five volumes of small to medium-sized gravel. The concrete is spread and thoroughly compacted to a depth of four inches by ramming, when the slab or flag divisions are marked off and markings cut three inches deep, the space made by the cutting tool to be immediately filled with dry sand and well rammed. The cement mortar coat consists of two volumes of Portland cement and three volumes of clean, sharp sand. The same when mixed is spread to a thickness of one inch upon the concrete base while the latter is still soft and adhesive, when it is to be leveled off and beaten with wooden battens, so as to break any air cells and make the surfacing perfectly solid and at the true grade. A coating of dry cement and fine sand in equal proportions, by volume, thoroughly mixed is then floated into the layer, when, after smoothing, the slabs are marked to a depth of one-half inch immediately over the markings made in the concrete. The slabs are then rolled with a toothed roller, leaving one inch margins.

Captain Beach also reports that he has "tried an experiment of rolling out the inequalities of an asphalt pavement with a heavy steam roller upon a day when the asphalt was so softened by the heat as to take the impressions of horse's hoofs"; the result, however, was not satisfactory.

Mr. George M. Ames, City Engineer of Grand Rapids, Michigan, reports several new features introduced into their street work, among which are brick gutters laid on graveled and on macadamized streets on foundations the same as used for the other portion of the street, with very satisfactory results. Also combination concrete curb and gutters with a band of steel ⅜ by 1¼ inch bedded in the face of the curb at street corners, the bands anchored with countersunk bolts. He also submitted a number of specifications for street work, among which is one for a screened gravel pavement.

In calling attention to the specifications for asphalt and brick pavements he says: "In the guarantee clause you will notice the A. S. M. I. ear marks." In these clauses is specified what shall be considered as pavement out of repair. In asphalt it is "wherever places show a disintegration of the material, or where elevations or depressions are more than three-eighths of an inch above or below the general surface of the pavement. Such irregularities to be measured from a straight edge four feet long placed parallel with the curbs or from a template placed at right angles to the curbs. Or, where cracks occur which show a disintegration of the material, or are more than three-eighths of an inch in width, or where the number of cracks in any fifty-foot section of the street exceeds the proportion of five feet of cracks to one lineal foot of pavement, or where the thickness of the asphalt is reduced more than that specified in the bid," while in brick pavements it is "wherever places show a disintegration of the material, or where elevations or depressions are more than one-half of an inch above or below the general surface of the pavement." These irregularities are to be determined as in the asphalt pavements.

This subject of determining what shall be considered a pavement out of repair is a very important one, but as far as possible these requirements should be uniform throughout the country for all pavements of similarly specified construction.

Mr. A. D. Thompson reports that he placed in the guarantee clause of his contracts for asphalt pavements the specifications adopted by this society at its last meeting, which defined the condition in which such pavement should be at the end of the guarantee period.

Mr. H. E. Terry, City Engineer of Saginaw, Michigan, writes that in order to determine whether the causes of any failure of any portion of the asphalt pavements laid since 1896 are due to any reason at the plant, he employed in addition to the inspectors upon the street a chemist and two inspectors at the asphalt plant, one for the day time and the other for the night, each working twelve hours.

The inspectors were to see that the mixes were made in accordance with the specifications, to keep a record of the quantity of materials used each day, note the time they were placed in the tanks, etc. The chemist was to analyze each shipment, the results of which with a specimen of each lot, properly labeled and numbered, was filed for future reference. Careful note was also taken of the exact location of the material on the street from which each specimen was taken.

This careful and systematic inspection will, if kept up, undoubtedly furnish much interesting information, besides enabling the engineer to get very closely at the actual cost of operating the plant and laying the pavement.

Annual reports show nothing new in the line of brick pavements, excepting that bricks of shale and fire clay mixed seem to have been more generally used.

Mr. C. C. Haven, City Engineer of Trenton, reports having laid brick in pavements lengthwise with the street, with the object of preventing somewhat the chipping of the edges due to the travel coming upon it. He states that fewer bricks are chipped or broken by the roller when laid in this manner and that the joints in the center are fully as well grouted as on the sides of the street, the cement not running from the crown of the roadway to the gutter, as is the case when the transverse joints run in a continuous line across the street.

His report for 1897 reveals considerable study upon the subject of brick pavements and contains much that is of interest.

In closing upon the subject of street pavements your committee desires to state that during the past year the white uniform for street sweepers has been generally adopted by quite a number of cities who recognize its many merits.

The reports received indicate that perhaps at no other time have there been such extensive improvements, either proposed or under process of construction, for the purifying and enlarging of the water supplies of the larger cities as at present.

New York City is at present engaged in increasing its storage capacity 32,000,000,000 gallons by the construction of the Croton dam, requiring over 600,000 cubic yards of masonry, and also by the building of Jerome Park Reservoir north of Harlem river, requiring over 4,000,000 cubic yards of rock and earth excavations and which will have a capacity of

1,500,000,000 gallons to be used for storage and distribution. These works will, when completed, bring the available storage capacity of the Croton water supply system to over 70,000,000,000 gallons.

The Metropolitan Water Board which at the beginning of this year took possession of the water works of Boston and of the adjoining cities and towns was organized late in 1895 for the purpose of providing and supplying an ample supply of pure water for the City of Boston, six other cities and six adjoining towns.

For this purpose it was required to construct a new storage reservoir having a capacity of 63,000,000,000 gallons, an aqueduct twelve miles in length, of finishing a reservoir commenced by the City of Boston to have a capacity of 7,500,000,000 gallons, of building new pumping stations and of laying great distributing mains from the reservoirs to the different cities and towns.

During the years 1896 and 1897 about nine millions of dollars have been expended in this great work. The aqueduct, the reservoir commenced by the City of Boston, the construction of a temporary dam necessary to divert the water of Nashua River into the aqueduct have all been completed and about 57,000 tons of large water pipes, over two thirds of which consisted of 48-inch, have been laid. This work has been most energetically pushed during the present season.

Albany, after many years of discussion and deliberation, is engaged in constructing a sedimentation basin of 16,000,000 gallons capacity, of eight masonry-covered filter beds and a pure water basin of 600,000 gallons capacity. The filter beds will be of the English type and have a daily capacity of 15,000,000 gallons. The water is to be delivered into the sedimentation basin in 296 small jets, thus offering aeration.

The City of Cleveland, for the purpose of increasing and improving the quality of its water, is building a new water tunnel of nine feet internal diameter and 26,000 feet in length. This undoubtedly will, when finished, be the longest submarine water supply tunnel in service. To further prevent contamination of the water supply at the new point of intake, the city is constructing an intercepting sewer system which will collect all the sewerage of the city and discharge the same near the bottom of the lake a long distance from shore at a point about ten miles east from the city.

The City of Chicago aroused to the fact that the construction of the costly drainage canal will not insure its citizens a pure water supply, has commenced the construction of several systems of extensive collection and diversions sewers.

These sewers are to parallel the lake shore from Evanston on the north to about Seventy-third street on the south and are to collect the sewerage and storm water of all the thirty odd sewers discharging at present into the lake along the entire front of Chicago and are to divert the flow of the same from the lake front to the rivers and thence to the drainage canal. One of these main sewers will cross the north side on Lawrence avenue and discharge by pump into the North Branch of the Chicago River, while another sewer, twenty feet in diameter, will cross the south side on Thirty-ninth street and discharge by pump into the end of one of the forks of the South Branch, alongside of the stock yards, and in this manner cause a flow in this the most stagnant slip of Chicago. Provisions will be made to pump, during dry weather, water from the lake into either of these channels. By this extensive work in connection with the drainage canal when completed, further discharge of any sewerage into the lake from within the limits of the city will be arrested and this almost constant source of pollution to some one of the many water supply tunnels be removed.

Minneapolis has just completed its large reservoir and steel pipe lines, a full exhaustive and interesting description of which work is given by F. W. Cappelen in his valuable report for 1897.

A number of cities along the Ohio River which are taking their water supply from that stream have determined to resort to sand filtration for the purpose of purifying the same. The Louisville Water Works Company, after an exhaustive series of experiments with a number of mechanical filters for a period exceeding a year, is constructing at present four settling basins and a clear water reservoir to be supplemented by an ample and extensive filtering plant.

The City of Cincinnati is at present engaged in the construction of a new water works plant at a cost of about $6.500,000. The water is to be taken from the Ohio River some distance above the city, pumped to two settling reservoirs upon high grounds, having a combined capacity of about 360,000,000 gallons. After three days' sedimentation the water is to be made clear and pure by sand filtration. When completed this filter plant will be the largest in service, having a capacity of not less than 60,000,000 gallons per day.

Pittsburgh has just completed a very thorough series of experiments upon purifying its water supply by filtration, which undoubtedly will result in the erection of a suitable filter plant.

Mr. J. C. Trautwine, Chief of the Water Bureau of Philadelphia, has just submitted a report for the filtration of all water used by the city together with an estimate of cost covering both slow sand filtration or the use of mechanical filters, based upon a capita supply of either 100 or 300 gallons per day. He recommends the appropriation of $300,000 for the restriction of waste and the construction of a filter plant for the Roxborough district at once.

Many smaller cities throughout the country are as deeply interested in the purification of their water supplies and quite a number have contracted for filtration plants.

In the examination of reports upon various municipal works your committee find continuous references made to grades which in each instance refer to local datum planes as a basis, which planes bear no relationship to the datum planes in any other city. The grades, therefore, convey no intelligent idea to the reader as to the relative elevations of these works or of the cities in which they are constructed compared with those with which he is familiar. The use of a general datum or reference plane throughout the country would at once convey knowledge of the relative elevation of locations and works which would be interesting and valuable in many ways. Although a change of base to such general datum is perhaps impracticable at the present time, yet a determination of the relationship of the plane adopted in each city to some general base or reference plane used by the United States government at the sea coast would, if used as a reference, enable anyone to obtain by comparison the relative elevations of the cities and their surroundings.

Mean tide at New York City might perhaps be adopted for such general base as I believe it has been used by the General Government and, transmitted or carried in its surveys to many cities in the interior and therefore with a little special effort its relationship to the local datum can be established and published in the annual reports.

THE PRESIDENT: The paper submitted on review is now open for discussion.

CAPTAIN BEACH: Mr. President, I would like to add a remark upon the subject of sidewalks in Washington, to what is stated in Mr. Benzenberg's paper. Since I wrote him I have been examining the walks very carefully and I wish now to refer to a suspicion that was pretty well established in my mind at the time I wrote but not sufficiently for me to assert it as upon proof, but which I now believe to be founded upon fact, and that is that in this locality our cement silewalks are more injured or more frequently thrown, as the technical expression is, by heat than by frost. I have had a great many engineers question the propriety of building walks as we do here without a frost base, but here the thermometer very seldom reaches zero. It has reached zero, I believe, but once in the four years that I have been here, and when it does that, which is very seldom, it scarcely ever remains at that point more than twenty-four hours, if that long. Our sun shines very hot here during the summer time.

The expansion from the heat has a greater destructive effect upon the walks than the uplifting effect of frost. Several walks have gone to pieces this summer, which was, I believe, the hottest summer that Washington has known since the Weather Bureau was established, whereas there has been but one case of a walk even injured by frost. The walk adjacent to the new Library building, which, I think, everybody who examines it will admit is well constructed, was thrown by the heat in such a manner that two of the blocks were thrown several feet in the air with a loud report, almost equal to that of a gun, the report being so loud as to be heard in the adjacent Library building and all the adjacent houses and stores. The explosion scattered some of the blocks, and those in the immediate vicinity were shoved, so that quite a little piece had to be relaid.

INDEX.

PART I.

BUSINESS PROCEEDINGS.

ADDRESS: PAGE.
    Of Welcome, Commissioner John B. Wright 21- 24
    Annual, President H. Van Duyne 25- 27
    By A. W. Campbell 51
    By G. T. Bouton 54
    By M. F. McLaughlin 57
    By J. M. Seymour, Mayor of Newark 59
    By R. H. Thomas, Mayor of Parkersburg 60

AMENDMENTS:
    To Constitution proposed 34
    Adoption of 41, 42, 43

COMMITTEES:
    Standing 4
    Nominating, appointment of 37
        Report of 44
    On Next Place of Meeting, appointment of 38
        Report of 49

CONSTITUTION;
    Constitution 9- 13
    Amendments proposed 34
    Amendments adopted 41, 42, 43

ELECTION:
    Of Members 28, 39, 40
    Of Officers 44

MEMBERSHIP: PAGE.

List of Cities 14
List of Members 15- 18
Election to 28, 39, 40

OFFICERS:

Officers 3
Election of 44
Responses of Newly Elected 44- 48

REPORTS:

Of Secretary 29- 30
Of Treasurer 31- 33
Of Finance Committee 33
Of Executive Committee 34
Of Nominating Committee 44

RESOLUTIONS:

To Dispense with Reading of Minutes 21
Of Thanks to District Commissioners, etc 60
Of Sympathy to Vice-President E. H. Keating and Family 61
Directing the Payment of Bills Due 61
Of Thanks to Retiring Officers 64
Referring Report of Committee on Municipal Data to Executive Committee 208

PART II.

PAPERS:

"RATES OF TAXATION IN THE LARGER CITIES OF THE UNITED STATES"—By Aug. Herrmann, Commissioner of Water Works, Cincinnati, Ohio 3- 26
Discussion of same 27

"REPORT OF A COMMISSION OF EXPERTS CONCERNING THE AGRICULTURAL UTILIZATION OF VIENNA SEWAGE"—Translated by Capt. L. H. Beach, Corps of Engineers, U. S. A. 28- 56
Discussion of same 82- 91

"THE SEWERAGE OF BALTIMORE"—By Kenneth Allen, Principal Assistant Engineer, Sewerage Commission of Baltimore 57- 62
Discussion of same 82- 91

PAPERS—CONTINUED. PAGE.

"THE SEWAGE DISPOSAL PROJECT FOR WASHINGTON, D. C."—By D. E. McComb, Superintendent of Sewers, Washington, D. C 63- 69
Discussion of same. 82- 91

"SOME OBSERVATIONS ON THE EFFECT OF FLUSHING DEVICES FOR SMALL SEWERS"—By A. E. Phillips, Assistant Engineer, Sewer Department, Washington, D. C. 70- 82
Discussion of same 82- 91

"WATER SUPPLY"—By M. L. Holman, Commissioner of Water Works, St. Louis, Mo. 91- 94
Discussion of same. 94- 96

"TREE PLANTING IN THE STREETS OF WASHINGTON"—By W. P. Richards, Assistant Engineer, Washington, D. C 97-101

"REPAIRS OF ASPHALT PAVEMENT IN BUFFALO"—By E. B. Guthrie, Chief Engineer, Buffalo, N. Y. 122-129
Discussion of same 158-173

"THE PROPER CURBING OF STREETS"—By Horace Andrews, City Engineer, Albany, N. Y. 130-137
Discussion of same. 172-173

"A STREET EXTENSION PLAN FOR THE ENTIRE DISTRICT OF COLUMBIA"—By Wm. P. Richards, Assistant Engineer, Washington, D. C. 138-144
Discussion of same 161-173

"SOME POINTS ON THE THEORY AND PRACTICE OF ASPHALT MIXTURES"—By A. W. Dow, Inspector of Asphalts and Cements, Washington, D. C 144-149
Discussion of same 161-173

"THE RELATIVE VALUES OF PAVING MATERIALS"—By George W. Tillson, M. Am. Soc. C. E., Brooklyn, N. Y. 149-157

"GARBAGE DISPOSAL"—By A. R. Reynolds, M. D., Commissioner of Health, Chicago. 173-176
Discussion of same. 177-187
Street Cleaning 208

"ELECTROLYSIS OF CAST IRON PIPES AT DAYTON, OHIO"—By Harold P. Brown 215-222
Discussion of same 222-228

REPORTS: PAGE.
Of Committee on Taxation and Assessment.................... 3- 26
  Discussion of same.................................... 27
Of Committee on Water Works and Water Supply............. 91
Of Committee on Electric Street Lighting.....................101-115
Of Committee on Street Paving..................................115-122
  Discussion of same.......................................158-173
Of Committee on Municipal Data...............................188-206
  Discussion of same..206-208
Of Committee on Coating of Cast Iron and Steel Rivetted Pipes..209-211
  Discussion of same..211-214
Of Committee on Review.......................................228-238
  Discussion of same..238-239

THE Executive Committee desires to call the special attention of the members of the Society to the advertisers. Let us help those who help us, and thus cause this book to be recognized as the valuable advertising medium it is.

GEO. H. BENZENBERG,

M. Am. Soc. C. E., M. Am. W. W. Ass'n,
M. Am. Soc. M. I., &c. &c.

CONSULTING ENGINEER
FOR MUNICIPAL, WATER AND SANITARY WORKS. MILWAUKEE, WIS.

This magazine is the foremost in the world devoted
municipal work. It has been said of it that "its volu
constitute the really valuable literature on the subject
municipal engineering."
It received the World's F
Award for excellence.

PAVING
SEWERAGE
MUNICIPAL
ENGINEERING
WATERWORKS
PARKS
A MONTHLY MAGAZINE
DEVOTED TO THE IMPROVEMENT OF CITIES
GOOD ROADS. STREET CONSTRUCTION, CLEANING AND LIGHTING, SANITATION, BRIDGES
PUBLISHED BY
MUNICIPAL ENGINEERING COMPANY
INDIANAPOLIS NEW YORK

From Detroit Journal.—Municipal Engine
has been a large factor in an educational way in
remarkable progress in the improvement of citie

From Philadelphia Press.—Municipal Engin
ing is itself a good example in enterprising and
gressive work.

From Kansas City Times.—Municipal Engin
ing is the most helpful publication in America t
who are interested in public improvements.

From Boston Herald.—Municipal Engineeri
full of valuable technical and professional informa

From Sacramento (Cal.) Record-Union.—E
municipal officer in the land ought to have and
Municipal Engineering.

From the Tacoma (Wash.) Daily Ledger.—
standard of Municipal Engineering is high.

Every number contains special articles by leading authorities. It gives all current
formation on new methods and ideas. It answers questions from subscribers on techn
matters. It contains the latest contracting news from the entire country.

A monthly magazine of 128 pages, illustrated.
Subscription—$2.00 a year; single copies, 25 cents; they are worth too much to be sent gratuitously. Address,

Municipal Engineering Co., 84-85-86 Commercial Club Bldg., Indianapolis.
275-A Washington Bldg., New York.

STOWELL & CUNNINGHAM,

CIVIL ENGINEERS,

NO. 51 STATE ST. *ALBANY, N. Y.*

Bridge Engineering, Design, Construction and Inspection.
Inspection of Cast Iron Pipe and other materials of construction.

CHAS. F. STOWELL, M. Am. Soc. C. E., Chief Engineer.
E. TOUCEDA, M. Am. Soc. M. E., Consulting Chemist and Metallurgist.

The Western Paving and Supply Co.

CONTRACTORS FOR

Trinidad Pitch Lake Asphalt Pavements.

The Ideal Pavement of Modern Times.
The Standard Pavement of America.
The Coming Pavement of the World.

Over ten million sq. yds. in use in the United States. It is smooth, durable, easily and cheaply cleaned, cheaply and perfectly repaired.

For Estimates and Particulars Address:

General Offices, 164 Lake St., CHICAGO, ILL.
Indianapolis Office, 340 W. Michigan St.
Milwaukee Office, 770 Commerce St.

COLUMBIA
CONSTRUCTION
COMPANY,

1205 Exchange
Court Building,
52 Broadway,

New York City.

MAIN OFFICE, No. 2 Warner Bldg., Syracuse, N. Y.
REFINERY, At Jones' Point.

IMPORTERS, EXPORTERS, REFINERS
AND DEALERS IN

Trinidad Asphalt

FOR PAVING, ROOFING, ELECTRICAL INSULATING
AND OTHER PURPOSES.

This Asphalt is mined on the Island of Trinidad, from the celebrated Deposits of the Countess Dundonald, and is, in all respects, the equal of the so-called Trinidad Lake Asphalt.

It has been used for a great number of years
With complete success for Asphalt Payments.

The David Folz Asphalt Paving Co.

Contractors for all kinds of

PAVING,

SEWERING, AND GENERAL PUBLIC WORKS.

Use Bermudez Pitch Lake Asphalt.

Room 2, Temple Court, CINCINNATI, OHIO.

Assyrian Asphalt Co.

Tacoma Building, CHICAGO.

ASPHALT PAVEMENTS the most durable of any

ASPHALT "FILLER." Elastic, will not disintegrate.

REFINED ASPHALTS of all kinds.

WRITE FOR PAMPHLETS.

Engineering News

contains more

Technical Articles for Civil Engineers,
Contracting Intelligence and
Proposal Advertising
than can be found anywhere else.

The Manual of

American Water-Works

is indispensable to all who are interested in that subject.

A sample copy of the one and sample sheets of the other will be sent free to any one mentioning this Advertisement.

The Engineering News Publishing Company,

Western Branch:
Monadnock Block, Chicago.

Publication Office:
220 Broadway, New York.

Extent of **Asphalt Pavements** in the United States and Canada.

Trinidad Lake Asphalt Pavement, 21,527,415 square yards, or 90 per cent.
Other kinds Asphalt Pavement, 2,307,064 square yards, or 10 per cent.

OF THE **Trinidad Lake Asphalt Pavement**

10,000,000
Square yards,
or nearly 50 per cent.

This is equal to about 650 miles of Roadway, 26 feet wide.

Was Laid By **The Barber Asphalt Paving Company.**

F. V. GREENE, PRESIDENT.

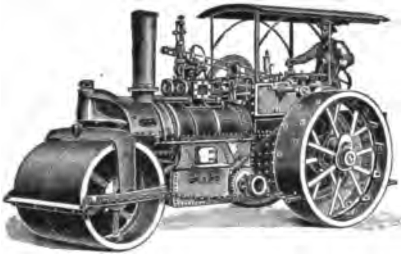
GENERAL OFFICES:

Le Droit Building, - - Washington, D. C.
Bowling Green Bldg., No. 11 Broadway, New York.

The Asphalt used by this Company is from the famous Pitch Lake in the Island of Trinidad, B. W. I.

PLANS AND ESTIMATES
Furnished on Application.

BUFFALO PITTS



HIGH GRADE **STEAM ROAD**

ROLLERS.

ASPHALT ROLLERS.

Buffalo Pitts Company,

BUFFALO, N. Y.

New York City,
150 Nassau Street.

Boston, Mass.
15 Court Square.

COMPAGNIE GÉNÉRALE des ASPHALTES de FRANCE,
(Limited.)

The Oldest Asphalt Company in the World.

PRINCIPAL OFFICES:
17 Coleman Street, London, England.
117 Quai de Valmy, Paris, France.
32 Broadway, New York.
204 Carondelet St., New Orleans, La.

MINES AND WORKS:
Seyssel & Mons, France, and Ragusa, Sicily
Quai de Valmy, Paris, France, and
New York Mastic Works,
Hunter's Point, New York City.

Standard Asphalt Pavements
OF EUROPEAN CITIES.

In which the Company's Pavements have been laid upwards of forty years and in use during the past seven years in the Cities of New York, Brooklyn, Boston, Philadelphia and New Orleans, also in Montreal and Ottawa.

THE EASTERN
PAVING BRICK
COMPANY

Manufacturers of

Vitrified Paving Brick,
Paving Blocks,
Sewer Brick, etc.

WORKS AT CATSKILL, N. Y.
AVERAGE DAILY CAPACITY, 125,000

NEW YORK OFFICE,
BOWLING GREEN BUILDING.

AFTER FEBRUARY 15TH,
ROOM 1312, EMPIRE BUILDING.

FRED. A. KUMMER, C. E.,
SALES AGENT.

NEW YORK
&
BERMUDEZ CO.

Importers, Refiners
and Dealers in

Bermudez Lake Asphalt,

STREET PAVING,
ROOFING COMPOUND,
RESERVOIR LINING,
MASTIC and
CEMENT.

* * *

GENERAL OFFICES:
BOWLING GREEN BUILDING
NEW YORK.
ROOM 1663. TELEPHONE, 1854 BROAD

REFINERY AND WORKS:
SOUTH AMBOY, N. J.

THE OASTLER STEAM ROAD Roller,

BUILT BY

The Cooke Locomotive Company,

PATERSON, N. J.

IS THE EMBODIMENT OF

STRENGTH,
SIMPLICITY and
DURABILITY.

Being manufactured in one of the best Locomotive shops in America, by the same mechanics and with the same high grade of materials of which Rail Locomotives are built, the care and completeness incidental and necessary to the permanent durability of such machines as Steam Rollers are assured.

The usefulness and POSITIVE SUPERIORITY in every particular, of the OASTLER ROLLER to any other Steam Roller manufactured, can be absolutely relied on.

Send for illustrations, descriptions and specifications to

W. G. OASTLER,
43 Exchange Place,
NEW YORK CITY.

Alcatraz Asphalt

Guaranteed free from Coal-tar
or Petroleum Residuum.

FOR

STREET PAVEMENTS.

TRADE MARK
ALCATRAZ
AA
ASPHALT.
REGISTERED

RESERVOIR LININGS,

Pipe Dip, Paints, Etc.

The Alcatraz Company,

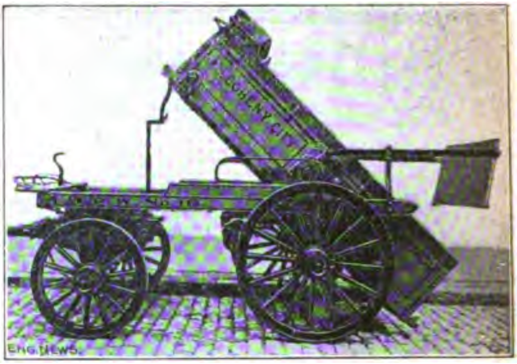
Crocker Building,

San Francisco, Cal.

New York Offices:
3 West 29th Street.

BECKERT'S

Eclipse Dumping Wagon



IS SUPERIOR TO OTHERS IN

Patented July 6th, 1897.

Equal Distribution of Load on Front and Hind Gears.
Load Balanced in Centre and under Control while dumping.
Quickly and Easily handled without getting off the wagon.
Simple in Construction; made to Last and Easy to Repair.

Manufactured by

WILLIAM BECKERT, 340 to 344 Ohio Street,
ALLEGHENY, PA.

Patent Tapping Machines,

For making Corporation Taps from ⅜ to 1⅛ in. inclusive
" " Valve Connections " 2 to 48 in. "

With any size Main, under light or heavy pressure.

Water Gates and Fittings,
Corporation Cocks,
Patent Lead Furnaces,
Patent Calking Machines,

Write for Circulars and Prices.

A. P. SMITH MF'G CO.,

NEWARK, N. J.

Mack Manufacturing Co.

.....Vitrified

Paving

Bricks

and

Blocks

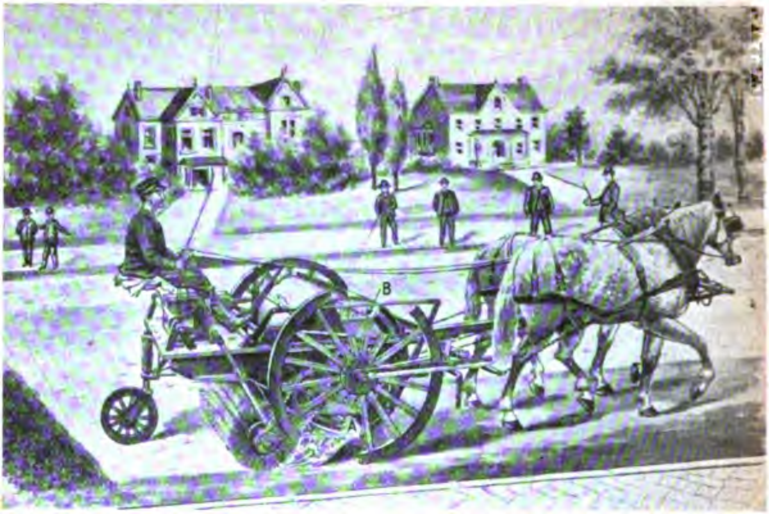
Of High Grade for Cities
and Towns.

GENERAL OFFICES,
WESTINGHOUSE BLDG, **Pittsburg, Pa.**

WORKS:

ROCKY SIDE, UNION, EAGLE, ÆTNA, CLIFTON,
CRESCENT, SLIGO, located at New
Cumberland, W. Va.

We invite correspondence from those desiring Vitrified Paving Material of acknowledged superiority in respect to durability, uniformity and beauty.



"MONARCH" Patented June 7, 1898.

A New Era in Street Sweeping.

The "MONARCH" Pick Up Street Sweeping Machine picks up thoroughly all dust, dirt and refuse found on the streets and at the same time collects and carries almost a cubic yard of sweepings along with it (similar to a Carpet Sweeper.)

The sweepings are deposited in the machine by the broom at A and are removed by a series of flexible scrapers and deposited in the tank at B.

The tank is emptied by reversing the lever on the axle to exactly an opposite position as shown in cut.

It will dispense with the large force of men required to broom sweepings into piles at the gutters.

The wire broom will last thrice the length of life of a fiber broom and can be refilled by any labor at a small cost.

The "MONARCH" PICK UP MACHINE is guaranteed.

For booklet and further information address

Improved Street Sweeper Co.

JOS. C. KANE,
SECRETARY AND TREASURER.

601 German Nat'l Bank Bldg.
PITTSBURG, PA., U. S. A.

In Corresponding mention this Report.

Special Terms to Street Cleaning Contractors.

Buffalo Portland Cement
Buffalo Cement

UNIFORM IN QUALITY
AND ALWAYS RELIABLE

MANUFACTURED BY

BUFFALO CEMENT COMPANY,
(LIMITED.)

110 Franklin St. BUFFALO, N. Y.

* * *

Crushed Stone, Screened to size

FOR ROAD MAKING
RAILROAD BALAST
CONCRETE, ETC. ETC

"Milwaukee Hydraulic Cement"

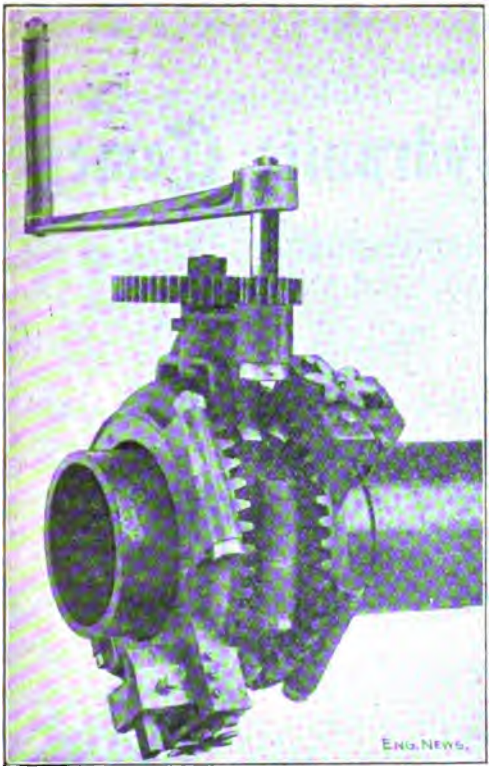
Correspondence Solicited.

For uniformity of grind and ultimate strength it stands unrivalled..............................

MILWAUKEE CEMENT CO.

Capacity, 4,000 Bbls. per day
Annual Sales, 500,000 Bbls.

MILWAUKEE, WIS.



VALVES
INSERTED IN
WATER MAINS
WITHOUT
SHUTTING OFF
THE SUPPLY.

SHERRERD & FRENCH CO.

Valves inserted and
branch connections
made under pressure.

Patentees and Manufacturers of

Valve Inserting Apparatus,

No. 1, Newark Street,

Machines sold or
Work done by contract.

HOBOKEN, N. J.

MEACHAM & WRIGHT,

Manufacturers' Agents for

Utica Hydraulic Cement,

ATLAS AND STEEL BRANDS OF
AMERICAN PORTLAND CEMENT

Dealers in

IMPORTED PORTLAND CEMENT, MICHIGAN AND
NEW YORK STUCCO.

308 and 309
Chamber of Commerce Bldg.

CHICAGO, ILL.

LEAD LINED IRON PIPE IS THE BEST PIPE FOR SERVICES. IT WILL NOT RUST OUT. HALF THE COST OF LEAD PIPE. . . .

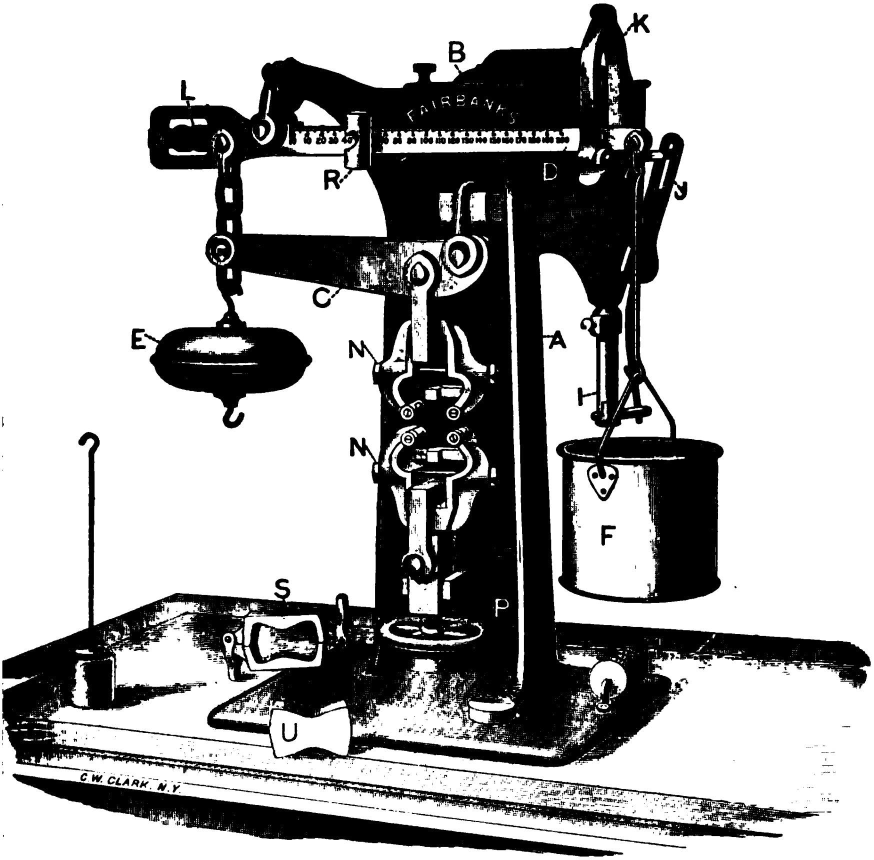
◆

Lead Lined Iron Pipe Co.

WAKEFIELD, MASS.

Fairbanks' PATENT AUTOMATIC

Cement Testing Machines



Descriptive Circular of Machines and Appliances, with Prices, Forwarded on Application.

The Fairbanks Company,

NEW YORK, N. Y.
PITTSBURGH, PA.
NEW ORLEANS, LA.
ALBANY, N. Y.
BOSTON, MASS.
BUFFALO, N. Y.
LONDON, ENG.
PHILA. PA.
BALTO. MD.
MONTREAL, CAN.

C. B. JOHNSON. President
J. J. WILSON, Vice President
E. H. BAILLIE, Secretary

CHAS. H. BERGEN, Chief Engineer
W. D. SHERMAN, Mechanical Engineer
H. A. MINER, Solicitor

F. B. JOHNSON, Treasurer.

THE WILSON & BAILLIE MANUFACTURING CO.

Main Office and Factory, 85-93 Ninth Street, Brooklyn, N. Y.

MANUFACTURERS OF

TRADE **KOSMOCRETE** MARK

Pronounced by Engineers who have seen the method of manufacture to have no equal.

Patent Machine Made "Portland Cement" SEWER PIPE,

EGG SHAPE WITH FLAT BASE.

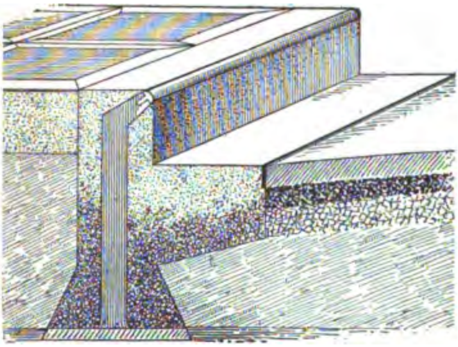
Can be laid to a Perfect Gradient.

KOSMOCRETE ARTIFICIAL STONE

For Sidewalks, Driveways, Copings, Steps, Railroad Depot Platforms, Flooring for Warehouses, Apartment Houses, Water-tight Cellar Floors and Improved Stable Floors.

Kosmocrete Steel-Bound Curb

"Wainwright's Patents."



The Steel-Bound Curb is superior to any natural stone.

Laid in twenty-foot lengths, with invisible joints, with concrete foundations, is never out of line.

Galvanized steel edges cannot rust or break.

It is the most beautiful and durable curb laid, and with gutter combined, is the ideal for asphalt or macadam streets.

HEAVY CONCRETE CONSTRUCTION A SPECIAL FEATURE OF OUR BUSINESS.

By permission we refer to the Engineers and Architects in charge of the following work:

Bowling Green Bldg., Kosmocrete walks laid on Broadway and Greenwich Street fronts.
Six miles of foundations for Union Elevated Railroad of Brooklyn.
Swimming Tank, Bergen Beach, Brooklyn.
Sea Wall, Wallabout Market, Brooklyn,
Causeway, New York Navy Yd., Brooklyn.
Sidewalks, Curbs, etc., Terminals, New York and Brooklyn Bridge.
Sidewalk, 5 miles long, 8 feet wide, Ocean Parkway, Brooklyn.
Sidewalks, Curbs, etc., N.Y. State Armories, 23d Regiment, Brooklyn; 14th Regiment, Brooklyn; Cahoes, Utica, Hornellsville.
Capitol, Albany, N. Y. Floor of Terrace, 10,000 sq. ft.
Sidewalk and Curb, Rensselaer Co Court House, Troy, N. Y.
Fireproof Floors, Abraham & Straus' New Warehouse, Brooklyn.
Watertight Cellers. Williams Building, 184 South St., N. Y., and many others.

This Company, in conjunction with Mr. T. Henry Dumary, are the successful bidders for constructing the Water FILTRATION Plant, Albany, N. Y. Contract Price, $309,866.47.

Engineers and Contractors are invited to inspect The Sherman Aerial Hoisting, Carrying and Distributing Apparatus which is employed in this work.

THE HIGHEST GRADE OF

AMERICAN PORTLAND CEMENT

IS

"IRON CLAD"

MANUFACTURED BY

The Glens Falls Portland Cement Co.

APPLY FOR FULL PARTICULARS, PAMPHLETS, PRICES, &c

SOLE SELLING AGENT

Commercial Wood and Cement Co.

156 Fifth Avenue, NEW YORK, and

Girard Building, PHILADELPHIA, PA.

[illegible] [illegible]

SIXTH ANNUAL CONVENTION.

* * *

American Society

OF

Municipal Improvements,

HELD AT

TORONTO, CANADA,

October 3d, 4th and 5th, 1899.

PROCEEDINGS

OF THE

Sixth Annual Convention

OF THE

American Society of Municipal Improvements

HELD AT

Toronto, Canada.

OCTOBER 3RD, 4TH AND 5TH,

1899.

THE NEW YORK
PUBLIC LIBRARY
318016

ASTOR, LENOX AND
TILDEN FOUNDATIONS
1905

SWAIN & TATE CO., MILWAUKEE, WIS.

American Society of Municipal Improvements.

... OFFICERS ...

1899-1900.

President	A. D. THOMPSON	Peoria, Ill.
First Vice President	ROBERT E. McMATH	St. Louis, Mo.
Second Vice President	BERNARD SAUNDERS	Toronto, Can.
Third Vice President	DR. WM. C. WOODWARD	Washington, D. C.
Secretary	D. L. FULTON	Allegheny, Pa.
Treasurer	F. J. O'BRIEN	Oswego, N. Y.

FINANCE COMMITTEE.

WILL B. HOWE	Concord, N. H.
JOS. EMMER	Grand Rapids, Mich.
WM. S. COOK	New Bedford, Mass.

EXECUTIVE COMMITTEE.

The officers of the Society, together with the Past Presidents, constitute the Executive Committee. The Past Presidents are as follows:

PAST PRESIDENTS.

M. J. MURPHY	St. Louis, Mo.
GEO. H. BENZENBERG	Milwaukee, Wis.
AUG. HERRMANN	Cincinnati, O.
HARRISON VAN DUYNE	Newark, N. J.
NELSON P. LEWIS	Brooklyn, N. Y.

Standing Committees.

Appointed by President in accordance with Article IV, Section 4, of the Constitution of the Society.

1899-1900.

STREET PAVING.

GEO. W. TILLSON	Brooklyn, N. Y.
W. B. HOWE	Concord, N. H.
B. J. T. JEUP	Indianapolis, Ind.

ELECTRIC STREET LIGHTING.

DAVID HUNTER, Jr.	Allegheny, Pa.
HAROLD P. BROWN	New York.
F. W. CAPPELEN	Minneapolis, Minn.

SEWERAGE AND SANITATION.

W. K. ELDRIDGE	La Fayette, Ind.
C. B. BALL	Washington, D. C.
FRANK V. BARDOL	Buffalo, N. Y.

WATER WORKS AND WATER SUPPLY.

GEO. H. BENZENBERG	Milwaukee, Wis.
G. BOUSCAREN	Cincinnati, O.
W. C. ALVORD	Chicago, Ill.

TAXATION AND ASSESSMENT.

AUGUST HERRMANN	Cincinnati, O.
GEO. T. BOUTON	Jersey City, N. J.
HARRISON VAN DUYNE	Newark, N. J.

CITY GOVERNMENT AND LEGISLATION.

CHAS. F. HERR	Newark, N. J.
ROBT. E. McMATH	St. Louis, Mo.
H. B. GNIFFKE	Dubuque, Iowa.

DISPOSITION OF GARBAGE AND STREET CLEANING.

JOHN JONES	Toronto, Ontario.
E. A. FISHER	Rochester, N. Y.
E. W. BOYNTON	Davenport, Iowa.

MUNICIPAL FRANCHISES.

ANDREW ROSEWATER	Omaha, Neb.
HARVEY J. WILEY	Wilmington, Del.
W. H. GLORE	Covington, Ky.

REVIEW.

GEO. M. AMES	Grand Rapids, Mich.
FRED. GIDDINGS	Atchison, Kan.
W. L. GLAZIER	Newport, Ky.

Special Committees.

Appointed by President in accordance with resolutions adopted by Society.

MUNICIPAL DATA.

C. C. BROWN	Bloomington, Ill.
L. E. FARNHAM	Camden, N. J.
DAVID HUNTER, Jr	Allegheny, Pa.

PARK DEVELOPMENT AND MAINTENANCE.

A. N. TALBOT	Champaign, Ill
CAPT. LANSING H. BEACH	Washington, D. C.
L. W. RUNDLETT	St. Paul, Minn.

NOTICE.

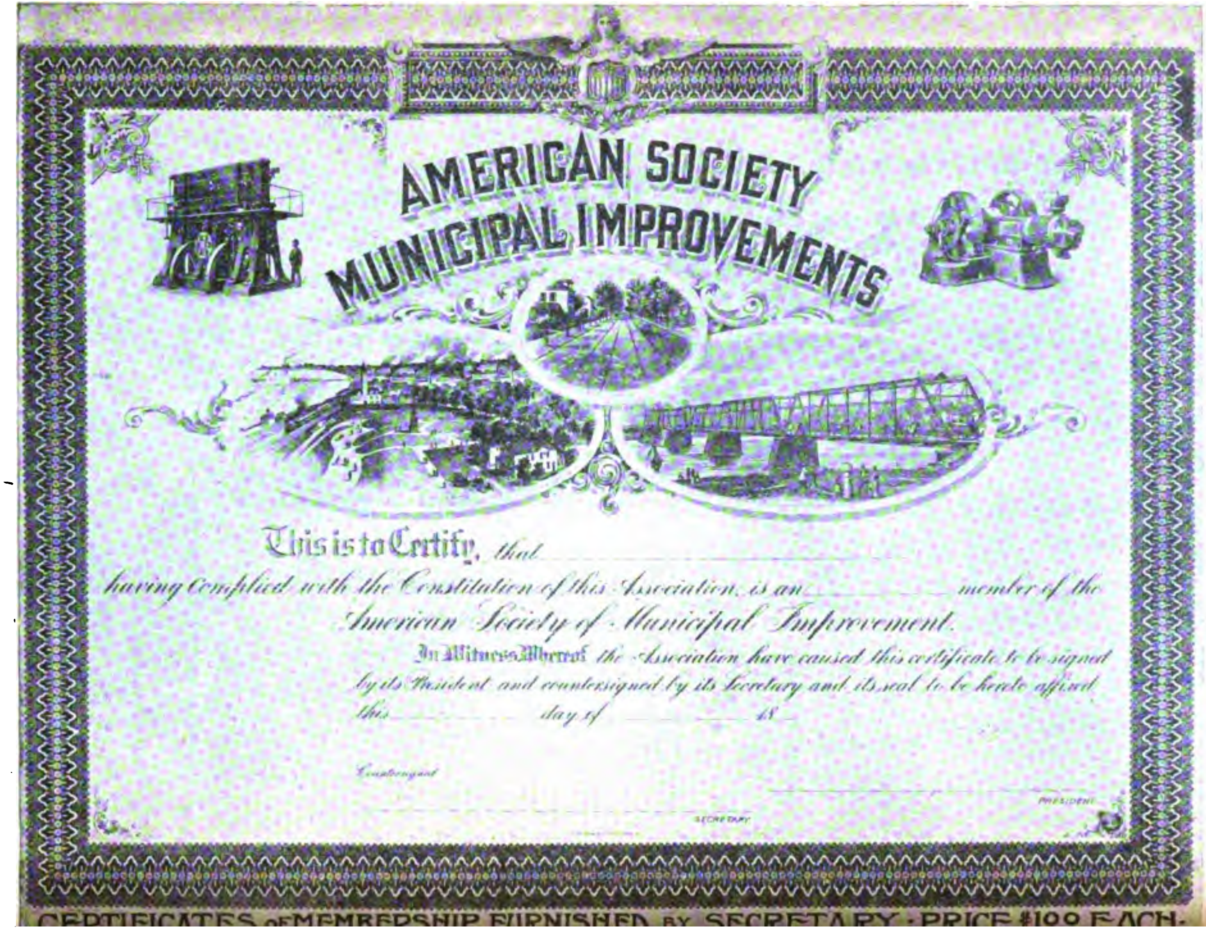
The annual reports for the former meetings are for sale by the Secretary at the following prices, including postage:

1895	25c	1897	$1.00
1896	$1.00	1898	1.00
		1899	1.00

Certificates of Membership handsomely engrossed, as per illustration on opposite page, $1.00 postpaid.

Initiation fee for each city	$5.00
Annual dues per member	5.00

Address all communications to the Secretary,
D. L. FULTON,
Allegheny, Pa.



AMERICAN SOCIETY MUNICIPAL IMPROVEMENTS

This is to Certify, that ____________________

having Complied with the Constitution of this Association, is an __________ member of the American Society of Municipal Improvement.

In Witness Whereof the Association have caused this certificate to be signed by its President and countersigned by its Secretary and its seal to be hereto affixed this ________ day of ________ 18__

Countersigned

____________________ SECRETARY

____________________ PRESIDENT

CERTIFICATES OF MEMBERSHIP FURNISHED BY SECRETARY: PRICE $1.00 EACH.

AMERICAN SOCIETY

OF

MUNICIPAL IMPROVEMENTS.

CONSTITUTION OF THE SOCIETY.

ARTICLE I.—NAME AND OBJECT.

Sec. 1. The objects of this society, which shall be known as "The American Society of Municipal Improvements," shall be to disseminate information and experience upon, and to promote the best methods to be employed in the management of municipal departments and in the construction of municipal works, by means of annual conventions, the reading and discussion of papers upon municipal improvements, and by social and friendly intercourse at such conventions, and to circulate among its members, by means of an annual publication, the information thus obtained.

ARTICLE II.—MEMBERSHIP.

Sec. 1. Any municipality within America shall be eligible to membership in this society; likewise any engineer, officer, or director who shall have charge of or supervision over, or be employed as a consulting engineer on any public or municipal department work. When a municipality has become a member of the society, then any person of such municipality representing any municipal board or department may also become a member.

Sec. 2. Every application for membership shall be in writing, stating the name, location, and department; and, if of an individual, shall also state the age, residence, and position of the applicant.

Sec. 3. Any member who shall have ceased to have charge or supervision of any public or municipal department or work may become an associate member, who shall enjoy all the rights and privileges of full membership, excepting that of holding office or voting.

Sec. 4. Any member who shall be in arrears for more than one year's dues shall be considered as no longer a member of this society, and his name shall be discontinued from the roll by the Secretary.

Sec. 5. Any member may withdraw from the society upon payment of all dues to date, and by notifying the Secretary thereof in writing.

Sec. 6. Any member may be expelled from the society upon the recommendation of the Executive Committee, adopted by a two-third vote of all the members present.

ARTICLE III.—Fees and Dues.

Sec. 1. Each municipality desiring to become a member of this society may do so by the payment of five dollars admission fee, which will entitle said municipality to as many members to said society representing boards or departments of said municipality as may be desired without any additional admission fee, but upon payment of the dues hereinafter prescribed.

Sec. 2. Municipalities shall not be required to pay any dues; but each individual representing any department of the municipality that has acquired a membership in the society, or any associate member, shall pay five dollars per annum as dues, the same to be payable on or before the date of the annual meeting.

ARTICLE IV.—Officers.

Sec. 1. The officers of this society shall consist of a President, three Vice-Presidents, a Secretary, and a Treasurer, each of whom shall be a resident of a different State, and who with the Past Presidents shall act as an Executive Committee for and in behalf of the society.

Sec. 2. There shall also be elected a Finance Committee, consisting of three members of the society.

Sec. 3. In case of any of the above positions, excepting the presidency, becoming vacant, or in case of their absence during the annual convention, the President shall fill such vacancy by appointment from the membership.

Sec. 4. There shall be appointed annually the following standing committees:

1. Street-Paving;
2. Electric Street-Lighting;
3. Sewerage and Sanitation;
4. Waterworks and Water-Supply;
5. Taxation and Assessments;
6. City Government and Legislation;
7. Disposition of Garbage and Street Cleaning;
8. Review;
9. Municipal Franchises.

The number on each committee shall be three, and the Chairman may add such names as he may deem advisable. No special or standing committee shall be authorized to create any liabilities unless the same shall have been first approved by the Executive Committee.

ARTICLE V.—ELECTION.

Sec. 1. The officers of this society shall be elected by ballot on the second day of each annual convention, and each municipality shall be entitled to as many votes as it has representatives present.

Sec. 2. The President shall not be eligible for immediate reëlection (except by a unanimous vote).

Sec. 3. The officers elected shall assume office immediately after the close of the annual meeting at which they were elected.

Sec. 4. The ballot for any officer may be waived by unanimous consent.

ARTICLE VI.—DUTIES.

Sec. 1. The President shall preside at the meetings of the society and at those of the Executive Committee, and shall perform such other duties as are incumbent upon the office. In the absence of the President, or upon his becoming ineligible, the senior Vice-President shall assume and perform the duties of the office.

Sec. 2. The Secretary shall keep accurate minutes of the proceedings of the society and of the Executive Committee; shall conduct all correspondence; shall issue notices of any meeting of the society not less than four weeks prior to the date of such meeting; shall collect and receipt for all fees and dues, and pay them to the Treasurer quarterly, taking his receipt for the same; and keep accurate account between the society and its members.

Sec. 3. The Treasurer shall receive from the Secretary and safely keep all moneys belonging to the society, giving his receipt therefor; shall pay all bills approved by the Finance Committee or the President; shall keep a correct account of the funds of the society, and submit to it at its annual meeting a report of all receipts and disbursements during the preceding year.

Sec. 4. The Executive Committee shall manage all the affairs of the society, subject to the action and approval of the society at its meeting. All questions in Executive Committee shall be decided by a majority vote, and five members shall constitute a quorum, not less than four of whom shall be officers of the society. The Executive Committee shall meet at least once each year, on the morning of the first day of the annual meeting of the society, and as much oftener as the President may determine. The Executive Committee shall be directed to keep an accurate list of the members of the society, and to ascertain from time to time whether or not such members are still municipal officers, and if not, to take such steps as may be necessary to secure new members from such cities in which members of the society are no longer municipal officers—this with a view of insuring the permanency of the association, as well as maintaining and increasing the membership thereof.

Sec. 5. The Finance Committee shall meet on the morning of the first day, and previous to the annual meeting of the society, to examine and audit the Secretary's and Treasurer's accounts and annual statements, and report thereon to the society.

Sec. 6. It shall be the duty of the Chairman of each standing committee to prepare a report, with the aid of his fellow-committeemen, and submit the same at the annual meeting.

Sec. 7. One afternoon, and such other time as may be deemed necessary, shall be devoted to sectional work, the Chairman of each standing committee acting as Chairman of the section. The Chairman of each section shall arrange the program of the sectional meetings in connection with the Program Committee of the society.

ARTICLE VII.—MEETINGS.

Sec. 1. The annual meeting of the society shall be held on the second Wednesday in October of each year, in such city as the majority of the members voting shall decide. Selection of place of meeting to be made after the officers shall have been elected. Provided, however, that the date may be changed for cause, with the approval of two-thirds of the Executive Committee, all the members to be notified of such change in accordance with Article VI, Section 2.

Sec. 2. At any annual meeting of the society fifty members shall constitute a quorum for the transaction of business.

Sec. 3. Any member, with the concurrence of the presiding officer, may admit friends to the meeting of the society, but such person or persons shall not without the consent of the meeting be permitted to take part in any discussion.

Sec. 4. All papers, drawings, etc., submitted to the meetings of the society shall be and remain the property of the society.

ARTICLE VIII.—ORDER OF BUSINESS.

Sec. 1. At the annual meeting of the society the order of business shall be as follows:

1. Roll call;
2. Reading of minutes of last meeting;
3. Considering of applications for membership;
4. The President's address;
5. Reports of the Secretary and Treasurer;
6. Report of the Executive Committee;
7. Report of the Finance Committee;
8. Reports of special committees;
9. Reading and discussion of papers;

10. Election of officers;
11. Selecting next place of meeting;
12. General business.

Sec. 2. All questions shall be decided by vote, and all differences of opinion in regard to points of order shall be settled by parliamentary practice as set forth in Cushing's Manual.

ARTICLE IX.—AMENDMENTS.

Sec. 1. The foregoing constitution and articles may be amended on or after the second day of any annual meeting of the society by a two-third vote of all members voting; provided such proposed amendment shall have been submitted to the society in writing on the first day of its annual meeting.

BY-LAWS.

No. 1. Members shall not be permitted to give out for publication any papers, to be submitted to the Society at its annual meeting, in advance of such meetings; and all requests for papers for such purposes shall be referred to the Secretary.

No. 2. All committees and members of the Society shall be required to furnish four copies of all reports, papers or other matters submitted to the Society for its consideration.

No. 3. It shall be the duty of the President, on or before the 1st day of January of each year, to divide America by States into Territorial Sections, and to assign one or more members of the Executive Committee to each of said sections. It shall be the duty of the members of the Executive Committee thus assigned to keep an accurate list of the municipalities and members of the Society in the particular territory assigned to them, and to ascertain, from time to time, whether or not the members of the Society from the territory assigned to them are still municipal officers; and when not, to take such steps as may be necessary to secure new members from such municipalities, as well as to secure membership in the Society of such municipalities and officials in the territory assigned to them that have not acquired the same in the past.

No. 4. The President shall be required, at least sixty days before the holding of the Annual Convention, to communicate with the local Committee having charge of the arrangements of the Convention in the city in which the same is to be held, with a view of securing exact data as to place of meeting, entertainment to be furnished, hotel and railroad rates, etc., and to print this information, together with such data relating to the business of the Convention as he may have, and turn the same over to the Secretary, or members of the Executive Committee, for distribution.

LIST OF CITIES HAVING A MEMBERSHIP IN THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.

Albany, N. Y.
Allegheny, Pa.
Atchison, Kan.
Akron, O.
Brooklyn (B'gh), N. Y.
Buffalo, N. Y.
Bloomington, Ill.
Binghamton, N. Y.
Bridgeport, Conn.
Burlington, Ia.
Bangor, Me.
Birmingham, Ala.
Cincinnati, O.
Concord, N. H.
Champaign, Ill.
Chilicothe, O.
Chicago, Ill.
Covington, Ky.
Camden, N. J.
Cleveland, O.
Calgary, Can.
Dayton, O.
Davenport, Ia.
Dubuque, Ia.
Dupont, Ga.
Eau Claire, Wis.
Ft. Wayne, Ind.
Grand Rapids, Mich.
Guelph, Can.
Halifax, Nova Scotia.
Hamilton O.
Harrisburg, Pa.
Hamilton, Can.
Indianapolis, Ind.
Jersey City, N. J.
Kalamazoo, Mich.
Lockport, N. Y.
Lafayette, Ind.
Lima, O.
Louisville, Ky.
Los Angeles, Cal.
Memphis, Tenn.
Mansfield, O.
Marietta, O.
Minneapolis, Minn.
Milwaukee, Wis.
Nashville, Tenn.
Newport, Ky.
Nashua, N. H.
Newark, N. J.
New Bedford, Mass.
New Haven, Conn.
New York, N. Y.
Omaha, Neb.
Oswego, N. Y.
Ottawa, Can.
Portland, Me.
Parkersburg, W. Va.
Peoria, Ill.
Plainfield, N. J.
Quincy, Ill.
Quebec, Can.
Richmond, Ind.
Rochester, N. Y.
St. Louis, Mo.
St. John's, N. F.
St. Paul, Minn.
Saginaw, Mich.
South Bend, Ind.
Syracuse, N. Y.
Sheboygan, Wis.
Toledo, O.
Toronto, Can.
Urbana, Ill.
Williamsport, Pa.
Wilmington, Del.
Washington, D. C.
Washington C. H., O.
Youngstown, O.
Zanesville, O.

American Society of Municipal Improvements.

MEMBERS.

1899-1900.

Albany, N. Y.	Horace Andrews	City Engineer.
Allegheny, Pa.	David L. Fulton	Supt. of Highways.
"	David Hunter, Jr.	Supt. Electric Light Plant.
"	G. C. Langenhein	City Engineer.
Atchison, Kan.	Fred Giddings	City Engineer.
Brooklyn, N. Y.	Nelson P. Lewis.	Engineer of Highways.
"	Geo. W. Tillson	Principal Asst. Engineer.
Buffalo, N. Y.	Frank V. Bardol	Chief Engnr. Dept. P. W.
"	Edw. B. Guthrie	Chief Engnr. Gr. C'g Com.
"	Michael J Healy	Commsnr. Public Works.
"	John H. Shifferens	Supt. Street Dept.
"	M. M. Drake	Chairman Bd. Pub Wks.
Bangor, Me.	Gilbert S. Vickery	City Engineer.
Binghamton, N. Y.	S. E. Monroe	City Engineer.
Birmingham, Ala.	Julian Kendrick	City Engineer.
Bloomington, Ill.	Chas. C. Brown	Consulting Engineer.
Calgary, Pr. Alberta, Can.	Chas. McMillan	City Clerk,
Champaign, Ill.	A. N. Talbot	
Chicago, Ill.	A. M. Reynolds	Health Officer.
"	John W. Alvord	Consulting Engineer.
Cincinnati, O.	M. J. Freiberg	Commsnr. Water Works.
"	August Herrmann	" " "
"	C. M. Holloway	" " "
"	L. Markbreit	" " "
"	W. B. Melish	" " "
"	G. Bouscaren	Chief Engnr. New W. W.
Concord, N. H.	W. B. Howe	City Engineer.
Covington, Ky.	W. H. Glore	Supt. Water Works.
"	Dan'l Segar	Commsnr. Water Works.
Davenport, Ia.	E. W. Boynton	Dept. Public Works.
Dubuque, Ia.	H. B. Gniffke	City Treasurer.

Grand Rapids, Mich.	Fred A. Twamley	Sec. Board Public Works.
"	Geo. M. Ames	City Engineer.
"	W. F. Johnson	Mem. Board Pub. Works.
"	Jos. Emmer	" "
Guelph, Ont	James Hutcheon	City Engineer.
Halifax, N. S	J. V. Hamilton	Mayor.
Hamilton, Can	E. G. Barrows	City Engineer.
Jersey City, N. J	Geo. T. Bouton	Sec. Street & Water Com.
"	Jas. S. Nolan	Ch. Street & Water Com.
"	Chas. A. Van Kewen	City Engineer.
"	F. Heintze	Com. Street & Water Bd.
"	Anthony Hauch	" " "
Lafayette, Ind	W. K. Eldridge	City Engineer.
Milwaukee, Wis	Geo. H. Benzenberg	Consulting Engineer.
"	S. J. Brockman	Board of Public Works.
"	Dan'l B. Bush	" " "
"	V. J. Schoenecker, Jr	" " "
"	Chas. J. Poetsch	City Engineer.
Minneapolis. Minn	F. W. Cappelen	Consulting Engineer.
Nashville, Tenn	Wm. M Leftwich, Jr	City Engineer.
"	John L. Kennedy	Com. Board Pub. Works.
Nashua, N. H	John F. Stark	Pres. Pennichuck W. W.
Newark, N. J	Ernest Adam	Engnr. St. & Water Com.
"	W. E. Greathead	Clk. Bd. St. & W. Com.
"	Chas. F. Herr	Commsnr. St. & W. Com.
"	Jas. M. Seymour	Mayor.
"	M. R. Sherrerd	Engnr. and Supt. Dept. W.
"	Harrison Van Duyne	Commsnr. St. & W. Com.
"	Geo. M. Ballard	Chairman Water Com.
"	C. V. Bauman	Street Commissioner.
"	J. B. Stobaeus	Mem. Board of Trade.
New Bedford, Mass.	Wm. S. Cook	Clk. Board Public Works.
"	John L. G. Mason	Pres. Common Council.
New York, N. Y	Harold P. Brown	Consulting Elec. Engineer.
Newport, Ky	W. L. Glazier	City Engineer.
Omaha, Neb	Andrew Rosewater	Pres. Board Pub. Works.
Oswego, N. Y	F. J. O'Brien	Supt. of Streets.
Peoria, Ill	A. D. Thompson	City Engineer.
"	Joseph Elder	Commsnr. Public Works.
"	Jacob A. Harman	Consulting Engineer.
Rochester, N. Y	Edwin A. Fisher	City Engineer.
"	Oscar Knebel	Chairman Executive B'd.

St. Louis, Mo	Robt. E. McMath	Pres. Public Improvem'ts.
Sheboygan, Wis	C. N. Boley	City Engineer.
Syracuse, N. Y	Robt. Ballard	Alderman.
St. John's, N. F	J. L. Slattery	City Treasurer.
Toronto, Can	John Jones	Street Commissioner.
"	Chas. H. Rust	City Engineer.
"	Bernard Saunders	Ald. and Chm. of Works.
"	J. C. Fullerton	City Counsel.
"	Chas. Sheard, M. D	Health Officer.
"	J. W. Burns	Board of Control.
"	John Chambers	Park Commission.
Quebec, Can	Jere Gallagher	Water Works Engineer.
Washington, D. C	Lansing H. Beach	Capt. Engineers, U. S. A.
"	A. W. Dow	Inspector Asphalt and C.
"	D. E. McCombs	Supt. Sewer Dept.
"	W. P. Richards	Surveyor.
"	A. E. Phillips	Asst. Engnr. Sewer Dept.
"	W. C. Woodward, M.D.	Health Officer.
"	Chas B. Ball	Plumbing Inspector.
Williamsport, Pa	Geo. D. Snyder	City Engineer.
Wilmington, Del	Harvey J. Wiley	Sec. Street & Water Dept.
"	Theo. A. Leisen	Park Engineer.

AMERICAN SOCIETY
OF
MUNICIPAL IMPROVEMENTS.

SIXTH ANNUAL CONVENTION,

TORONTO, CANADA, OCTOBER 3d, 4th and 5th, 1899.

TUESDAY, OCTOBER 3d, 1899—MORNING.

The Sixth Annual Convention of the American Society of Municipal Improvements met at the City Building, Toronto, Canada, October 3d, 1899, at 10:30 a. m., and was called to order by the President, Mr. Nelson P. Lewis.

Alderman Saunders, Chairman of the Board of Works of the City of Toronto and Chairman of the Reception Committee, introduced Mr. John Shaw, Mayor of the City of Toronto, to the meeting:

MR. SHAW:

MR. PRESIDENT AND GENTLEMEN:

Permit me to introduce to you Aldermen Hallam, J. J. Graham (of the Reception Committee), Shepherd Crane (of the local Board of Health), Franklin (Fire and Light Committee), Russell, Spence and Bowman, as some of our representatives. Our municipal government is composed of twenty-four Aldermen and the Mayor.

I am pleased, Mr. President, ladies and gentlemen, to be here this morning to welcome you to the city of Toronto in convention. We feel always honored to know that people think it worth while to come to our city: and especially do we feel it an honor when delegates from the other side of the line, engaged in the work that this Society is engaged in, honor us by coming here. We have had the pleasure to be told by some of those who have come here before that our municipal government is a pretty good one—we do not say so but they say so. But no doubt you will see for yourselves, as we see, on closer inspection that there are a great many defects in our municipal system, just the same as in every municipal system. But all these defects, I think, owing to the general trend of interest that is being taken now in municipal matters, will in time be removed. I think one of the highest things, perhaps, a community has to do is to deal with the municipal government; it is something .that pertains to the comfort, the convenience, the health and life of every community, and it requires people of versatile minds to grasp in a large city all the variety of details of municipal government and to deal wisely and well with all the interests that are intrusted to them. We find difficulties enough here; and you, I have no doubt, have your own difficulties on the other side.

We do not boast of any great perfection any more than any other city; but, as I said before, the people who come here are good enough to say they think there are some things in our municipal system that could with advantage be transferred to theirs, and I have no doubt there are some things in their systems of municipal government that might be transferred to ours.

We have a nice city. We are proud of Toronto, and proud of this big building that we have at last got into after long years of patient waiting. I understand that this is the first time this Convention has ever met in a municipal building, and I am pleased and honored, and we all feel pleased and honored, to know that this Society, coming from the United States, is meeting in this building of ours. This will be a red letter day for us; and we hope that the deliberations which you are about to engage in will be productive of good results, and that our city will please you, and that our people will pease you. We will endeavor to show you what hospitality we can, and to strive to make your stay here welcome, and pleasant, and agreeable.

Alderman Graham, the Chairman of the Reception Committee, has been indefatigable in looking after conventions, especially American conventions, and I notice that one of his daughters has been captured by a young gallant from the United States who came here in convention. And while we do not want to see our girls taken away by Americans, still, if they are going to fall into any other hands than our own, we would rather they should fall into the hands of Americans. (Applause.) Aderman Saunders was with you in convention last year, and I am sure he will be only too pleased, as will all our aldermen and all our officials, to assist you in making the deliberations of this Convention profitable, and your stay with us a pleasant one.

I have very much pleasure in welcoming you to the city.

THE PRESIDENT: Permit me, on behalf of the Society, to express to Your Worship, and through you to the city officers and people of Toronto, our hearty appreciation of your warm words of welcome. I am sure that we could have chosen no better place for holding our Convention, did we consult our profit or our pleasure.

The parent branch of the Anglo-Saxon race has certainly manifested a genius for municipal administration which it is often thought her offspring have been somewhat slow to emulate. But this work of carrying on the government of great cities is part of the "white man's burden," and we must work it out together; and it must be approached with those qualities which you have conspicuously inscribed on the great window on your main staircase—"Industry, Integrity, Intelligence."

The United States Ambassador at the Court of St. James, when asked by a stranger whether he was an Englishman or a foreigner, promptly replied: "Neither; I am an American." So, those of us who come from the States come not as foreigners, but as cousins. You have bidden us a welcome in a hearty manner, which makes us feel at home; and I believe I may say that, next to being citizens of our own great Republic, we would choose to own allegiance to that gracious lady whose name is revered wherever a chivalrous people honor and love a noble womanhood, and who is your Queen.

You have generously placed at our disposal your beautiful new municipal building for the session of our Convention—a building which reflects great credit upon your city, and which seems to be admirably adapted to the purposes for which it was designed.

Permit me again to thank you for your warm welcome and for the generous hospitality you have shown in placing this building at our disposal.

THE PRESIDENT: We will now proceed with the regular work of the Convention. The first order of business is "The reading of the minutes of the last meeting." These minutes have been already printed in our Annual Report; is it your pleasure that they be read?

On motion, the reading of the Minutes was dispensed with.

CONSIDERING APPLICATIONS FOR MEMBERSHIP.

The names of the following gentlemen were submitted as applicants for membership:

George M. Ballard, Newark, N. J.
C. V. Baumann, Newark, N. J.
J. B. Stobaens, Newark, N. J.
Joseph E. Elder, Peoria, Ill.
John L. G. Mason, New Bedford, Mass.
Joseph Emmer, Grand Rapids, Mich.
J. S. Fullerton, Q. C., Toronto, Can.
Charles Sheard, M. D., Toronto, Can.
A. E. Foyé, New York City.
J. V. Hamilton, Halifax, Nova Scotia.
Charles J. Poetsch, Milwaukee, Wis.
V. J. Schoenecker, Milwaukee, Wis.
William T. Johnston, Grand Rapids, Mich.
J. W. Alvord, Chicago, Ill.
G. Bouscaren, Cincinnati, O.
James Hutcheon, Guelph, Can.

On motion, the Secretary was instructed to cast a ballot for the gentlemen named above.

The Secretary cast a ballot.

THE PRESIDENT: The Secretary reports that a ballot has been cast electing the following:

George M. Ballard, Newark, N. J.
C. V. Baumann, Newark, N. J.
J. B. Stobaens, Newark, N. J.
Joseph Elder, Peoria, Ill.
John L. G. Mason, New Bedford, Mass.
Joseph Emmer, Grand Rapids, Mich.
J. S. Fullerton, Q. C., Toronto, Can.

Charles Sheard, M. D., Toronto, Can.
A. E. Foyé, New York City.
J. V. Hamilton, Halifax, Nova Scotia.
Charles J. Poetsch, Milwaukee, Wis.
V. J. Schoenecker, Milwaukee, Wis.
William T. Johnston, Grand Rapids, Mich.
J. W. Alvord, Chicago, Ill.
G. Bouscaren, Cincinnati, O.
James Hutcheon, Guelph, Can.

and I therefore declare them duly elected members of the American Society of Municipal Improvements.

THE PRESIDENT: The rgular order of business provides that "The President's Address" shall come next, and I will therefore ask your attention for a few minutes.

THE PRESIDENT'S ADDRESS.

Before beginning the serious work of the Sixth Annual Convention, we may advantageously pause for a brief consideration of the objects which brings us here, the work accomplished by the Society, and its prospects and possibilities for future usefulness. There is no one subject which is receiving more attention and discussion at the present time than that of Municipal Improvements. There seems to be a universal tendency among all the peoples of the world to concentrate in large cities. This tendency was clearly shown by the census of 1890, and will doubtless be still more forcibly indicated by that of 1900. In 1890 over 45 per cent. of the population of the State of New York was contained in four cities; while it is estimated that nearly, if not quite 50 per cent. of its present population, is concentrated in the Greater City of New York.

It is a stupendous undertaking to provide for so many people homes and environments which shall be healthful and convenient, highways smooth, handsome and well lighted, a pure water supply and sanitary drainage, together with parks and recreation grounds; to dispose of the enormous quantity of waste materials; to afford ample police and fire protection, and the many other things which make for health, convenience, beauty and commercial prosperity.

I have endeavored to ascertain roughly the amounts annually expended for these purposes in our American cities. According to the census of 1890 there were in the United States 212 cities having a population of 15,000 or more, with a total of 17,298,662, and I have obtained statistics, more or less complete, from 78 of them. Assuming that these represent a fair average of the per capita expenditures, I find that the sums spent during the year 1898 for municipal improvements must have been about as follows:

For improvement and care of streets	$49,301,187
For water supply	32,867,458
For sewerage	14,057,142
For public lighting and public buildings	26,779,847
For parks and bridges	22,198,566

In addition to this, the cost of police and fire protection reached the enormous total of $66,339,023.

Now, I am convinced that the above figures fall far short of representing the total expenditures for such purposes, for you all know how difficult it is to obtain accurate information of this kind. In comparatively few instances could I secure data concerning the expenses of street cleaning and the removal of wastes, and such as were obtainable are included in the cost of the care of streets. The expenditures for water supply are also greatly underestimated, as many municipal officers appear to think that if the expense of providing and distributing water is not included in the general tax levy nor provided by the sale of bonds, but is met by the proceeds of the sale of water to the consumers, it is not, therefore, a direct city charge. Many of the smaller cities are supplied by private water companies, and the cost of such a service is not ascertainable. The foregoing statement does not include water front improvements, though there was expended for such purposes in New York alone during the last year $3,710,294; nor does it include the vast sums expended in education, libraries, museums, public baths, public markets, charities and corrections, nor the expenses of executive offices, and departments of finance, assessment and collection. The sum raised for all purposes in New York last year, exclusive of that for State taxation and the redemption of and interest on bonds, but including new bond issues, was, according to the Comptroller's report, $109,593,440, and if this same ratio had obtained in the 212 cities above referred to, the total expense of administering them would have been nearly 535 millions of dollars, and this would include but a small proportion of the expense of supplying these cities with water, or of improvements payable by special assessment. It must be remembered that the expenditures given are those for 1898, while the population is for 1890, so that the ascertainable per capita tax expense appears larger than it should; but this error is trifling when compared with the underestimate due to my inability to obtain full information. No attempt was made to collect information from cities which had less than 15,000 population in 1890, while scores of towns have reached and passed this limit since that date, when there were 490 whose population was between 5,000 and 15,000.

And there are other vast sums annually expended for purposes distinctly municipal, and in which the members of this Society are deeply interested, but which it is the almost universal custom to leave to private enterprise, such as the construction and operation of railways for urban and interurban travel, the supplying of light, heat and power for domestic and manufacturing purposes, the transmission of messages by telegraph and telephone, and the building of subways or aerial lines for the accommodation of the necessary electrical conductors, pneumatic tubes, etc.; in short, for all the various utilities which seem to have become necessities to our present civilization. All of these enterprises come into contact with our municipal administration at so many points that it has often occurred to me that it might be well to bring the men engaged in them into closer touch with ourselves through the medium of this Society, so that the great problems which concern us may be more intelligently studied.

Now, as to the work which has been accomplished by the Society during the four years which have followed that number of working conventions (for the first meeting was simply one of organization)— I say working conventions advisedly, for they have not furnished excuses for junkets; and while it has been a genuine pleasure to meet personally and in a social manner the officers of the seventy-five cities whose names appear upon our rolls, the most conspicuous features of these meetings has been the serious work which has been accomplished. One notable result of this can be seen in the marked tendency toward uniform and better practice in carrying out municipal work as indicated by the specifications which have been prepared during the last two years.

If you in Toronto have tried some new and successful method in street or sewer construction, in street cleaning, lighting, or garbage disposal, it has been brought out in open discussion or personal conversation, and you will find next year that it has been adopted in cities hundreds or even thousands of miles distant.

There is no man to whom an opportunity to compare notes with those of like occupation is more necessary than the municipal officer. City-making, while one of the oldest of man's occupations, is still a new art, and what were a generation ago considered urban luxuries are now necessities to the humblest inhabitant of our great cities. The municipal officer may read all the books which have been printed upon the science of municipal government; he may attend lectures by all the eminent reformers: but what he wants is to be able to see things as they are, not as some one else thinks they ought to be. These conventions have afforded just this opportunity. Busy men have dropped for a few days the routine drudgery of their offices and have met together to see how others are solving the same problems upon which they are engaged.

The Society is also to be congratulated upon the consistency with which it has adhered to the objects set forth in its Constitution. These objects are eminently practical, and are described as "the dissemination of information and experience upon, and to promote the best methods to be employed in the management of municipal departments and in the construction of municipal works."

These objects have been kept steadily in view, and our conventions have not been used for the exploitation of wild theories of municipal government, nor as a means of advertising for those who have goods to sell or political reputations to achieve.

And now a few words as to the future. The printed reports of our conventions contain probably the most valuable collection of papers on municipal works which are published in any one volume. The high character of this publication must be maintained, and it must be brought to the attention of municipal officers in all parts of the country. I would suggest to the Executive Committee the advisability of advertising the next issue of our proceedings, offering it to subscribers at a price somewhat greater than that charged to members. I believe that a more general distribution of these proceedings would add materially to our membership.

During the coming year the 12th U. S. Census will be taken, and it has been frequently suggested that the Census will not be complete unless it includes statistics concerning municipal government and improvements. I think the crude facts I have already given you leave no question as to the importance of the matter, and demonstrate that such information is worthy of an important place in the federal Census. It has been contended that such statistics, to be of any value, must be accurate and exhaustive, and that it is well nigh impossible to secure complete information upon such subjects, owing to the indifference of municipal officers, or their unwillingness to take the trouble to collect and furnish such information. I recognize from my own limited experience the difficulties of the task, but feel that its great importance is worthy of the effort, and that this Society can render valuable assistance to the federal authorities in this work. I have written to the Superintendent of the Census, assuring him of the co-operation and assistance of the Society in case he attempts to collect such statistics, and he has in reply stated that the four great items of population, vital statistics, agricultural and manufacturing schedules will be finished before special subjects are taken up. He further says that when the time comes for taking up such subjects he will be glad to consider our offer and has no doubt that we will be able to be of great service in furnishing information concerning the cities of the country.

We stand to-day upon the threshhold of a new century. Looking behind us we note the wonderful development of our Nineteenth Century cities, not only in this country, but over the entire world. Will this development continue, and will the people of the world continue to mass themselves by the millions in our great cities? If so, the municipal officers will be those who bear the greatest responsibilities, and men who have been tried and found efficient will be retained in office; and we will not see, as we have during the past year, three important officers in the three most progressive cities of our great Northwest allowed to retire after many years of faithful and efficient service, because they were not in political sympathy with their Mayors.

Much satisfaction can be derived from the admirable administration during the past year of the cities in Cuba and Porto Rico by the trained officers of the United States army. Their affairs have been conducted with notable efficiency, and the improvements inaugurated have been remarkable. If this high standard is maintained, it is not unreasonable to expect that this system will be copied by our home cities, and the parent government can learn a valuable lesson from the work done in the colonies.

As we look forward dim figures appear through the mists of futurity, bearing different legends—social reform, the brotherhood of man, universal peace, sound finance, national ownership of railways, and many others. Some walk with faltering step, uncertain of their place upon this stage; but one figure, more commanding than the rest, bears the legend: "Municipal administration." Among the jewels in her crown are, wise economy, fidelity to public trust, good sanitation, civic pride, sure tenure of office for faithful employees. Is this only an illusion? It must be realized if our people are to appreciate the importance of the problems which confront them. In helping them to such a realization this Society can play an important part, and I earnestly hope it may materially contribute to that end.

THE PRESIDENT: The next business is the report of the Secretary.

The Secretary, Mr. D. L. Fulton, read the following report:

REPORT OF THE SECRETARY.

ALLEGHENY, PA., SEPT. 30, 1899.

TO THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS:

SIRS: I have the honor to present the following report as Secretary for the past year, beginning October 10, 1898, and closing September 30, 1899:

RECEIPTS.

Initiation fees from four cities	$20.00
Dues from 89 members at $5.00 each	445.00
Dues from three members at $3.00 each	9.00
Sale of nine reports, 1895	2.25
Sale of four reports, 1896	4.00
Sale of twenty reports, 1897	20.00
Sale of 128 reports, 1898	128.00
One certificate of membership	1.00
One-eighth page advertisement	5.00
One-fourth page advertisement, three at $7.00	21.00
One-half page advertisement, nine at $12.00	108.00
Full page advertisement, twelve at $20.00	240.00
Outside cover page advertisement	30.00
Total	$1,033.25

DISBURSEMENTS.

Nov. 1, 1898., paid Treasurer Kennedy	$306.25
Dec. 2, 1898, paid Treasurer Kennedy	135.25
Feb. 6, 1899, paid Treasurer Kennedy	34 25
Mar. 13, 1899, paid Treasurer Kennedy	88.00
Mar. 15, 1899, paid Treasurer Kennedy	57.00
Mar. 17, 1899, paid Treasurer Kennedy	60.00
April 7, 1899, paid Treasurer Kennedy	31.00
April 15, 1899, paid Treasurer Kennedy	59.75
May 11, 1899, paid Treasurer Kennedy	66.00
May 13, 1899, paid Treasurer Kennedy	26.00
July 20, 1899, paid Treasurer Kennedy	78.00
July 28, 1899, paid Treasurer Kennedy	20 00
Aug. 19, 1899, paid Treasurer Kennedy	71.75
Total	$1,033.25

RECAPITULATION.

Total receipts, Oct. 10, 1898, to Sept. 30, 1899	$1,033.25
Amounts sent Treasurer Kennedy during same dates	1,033.25

I am very glad to be able to report that the receipts during the past year have been sufficient to pay all bills and clear up a small debt which was against the Society, so that we enter upon the present year with a small balance, and this fact is due to the untiring efforts of our President, and some of the Executive Committee who helped the President carry out a suggestion, viz., to solicit some advertisement for our annual report, and my report will show that without the money collected for these advertisements we would have been short of money to carry on the work during the year.

During the past year I have carried on the correspondence of the Society, answered all inquiries made about our work, and used my best efforts to further the interests in a society which I believe has been of much benefit to all its members, as well as the officers of many cities who have not taken an active interest in the Society.

My official duties do not allow me to give as much time to the Society as one who has no other employment, and I believe if the Society was in a financial position to employ a secretary who could give his undivided attention to the work, that the membership could be materially increased.

I have to report that the entire issue of the report of 1896 has been exhausted. As it contained a report of the cost and maintenance of electric light plants, it was in great demand while it lasted. One other reason why it was exhausted so soon was that the Secretary was instructed to send one report to the Mayor of each city represented that year, which took some seventy-five copies.

The printing of the report last year was accomplished in a very short time after the convention adjourned. This was possible from the fact that it was handled quickly by all of the Executive Committee, who looked over the report before it went to the printer's hands.

The President, Mr. Lewis, and Messrs. Van Duyne, Herrmann and Benzenberg gave considerable of their time to the preparation of the work, and the excellence of the report and quickness with which it was printed is due to them.

Besides notifying the members of the present meeting, sending out programs, etc., I have sent notices to several hundred people whose names I have secured during the past year from correspondence and from members of the Society, in the hopes that we might interest city officials in our work.

I desire to thank the officers and members of the Society for their kind assistance during the past year.

I am, most respectfully,

D. L. FULTON,
Secretary.

THE SECRETARY: I might state, in reference to those three items of $3 each, making a total of $9, that the annual dues previous to this past year were $3, and that a number of the members who did not attend the Washington Convention sent me $3 each. I then notified them all that the dues had been increased to $5, and they all responded with the extra $2, except these three gentlemen. This explains the reason why there are those three payments of $3 each for dues.

On motion, the report of the Secretary was referred to the Finance Committee.

THE PRESIDENT: The report of the Treasurer is now in order. Mr. Kennedy, our Treasurer, is again unable to attend the Convention, but he has sent a copy of his report, apparently, to all the members of the Executive Committee. The Secretary will now read the Treasurer's report.

THE SECRETARY: I have the report of the Treasurer, together with the receipted bills.

The Secretary read the report of the Treasurer, as follows:

REPORT OF THE TREASURER.

TO THE HONORABLE THE FINANCE COMMITTEE OF THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS, IN SESSION AT TORONTO, CANADA, OCTOBER, 1899.

The undersigned hereby exhibits an account of his receipts and disbursements as Treasurer of the said Society during the fourth year in which he has served in that capacity, beginning October 26, 1898.

CASH RECEIPTS.

1898.		
Oct. 26....	Amount cash on hand as per settlement approved by your Finance Committee in session at Washington...	$6.72
Nov. 4th...	From D. L. Fulton, Secretary	306.25
Dec. 5th...	From D. L. Fulton, Secretary	135.25
Dec. 9th...	From N. P. Lewis, President A. S M. I.	20.00
1899.		
Feb. 8th...	From D. L. Fulton, Secretary	34.25
Mar. 15th..	From D. L. Fulton, Secretary	88.00
Mar. 17th..	From D. L. Fulton, Secretary	57.00
Mar. 20th..	From D. L. Fulton, Secretary	60.00
Apr. 11th..	From D. L. Fulton, Secretary	31.00
Apr. 17th..	From D. L. Fulton, Secretary	59.75
May 13th..	From D. L. Fulton, Secretary	66.00
May 15th..	From D. L. Fulton, Secretary	26.00
July 22d...	From D. L. Fulton, Secretary	78.00
July 31st...	From D. L. Fulton, Secretary	20.00
Aug. 21st..	From D. L. Fulton, Secretary	71.75
		$1,059.97

DISBURSEMENTS.

1898.		
Nov. 15th..	Paid John E. Rowe & Son, Newark, acct. approved by Van Duyne and Fulton	$28.25
Nov. 15th..	Paid T. A. McNairy, acct. approved by Lewis & Fulton	5.25
Nov. 15th..	Paid D. L. Fulton, acct. approved by Fulton & Lewis	5.25
Nov. 15th..	Paid D. L. Fulton, Secretary, salary for 1897	100.00
Nov. 15th..	Paid Harrison Van Duyne, acct. approved for amount advanced by him to A. S. M. I. in 1898	100.00
Dec. 6th...	Paid Wm. Herbert Smith, acct. for reporting proceedings of meeting in 1898, approved by Lewis & Fulton	112.00
Dec. 17th..	Paid Brown, Bierce Co., Dayton, acct. approved by Lewis, Fulton and Herrmann	16.50
Dec. 22d...	Paid Commercial Gazette Job Printing Co., acct. approved by Lewis, Fulton and Herrmann	47.50
1899.		
Feb. 7th...	Paid Freidenwald Co., on acct. approved by Lewis, Fulton and Herrmann	50.00
Feb. 8th...	Paid on same account	35.00
Mar. 15th..	Paid balance on same account	5.00
Mar. 18th..	Paid D. L. Fulton, Secretary, acct. approved by Lewis	21.85
Mar. 18th..	Paid Swain & Tate Co., on acct. (for $333.45) approved by Lewis, Fulton and Benzenberg	100.00
Mar. 21st..	Paid Swain & Tate Co., on same account	58.45
Apr. 18th..	Paid Swain & Tate Co., on same account	100.00
May 15th..	Paid Swain & Tate Co., balance of same account	75.00
May 15th..	Paid N. P. Lewis, acct. for sundry expenses, approved by Fulton and Lewis	15.15
Sept. 18th..	Paid D. L. Fulton, Secretary, salary for 1898	100.00
		$975.20

RECAPITULATION.

Total receipts:		
From D. L. Fulton, Secretary	$1,033.25	
From N. P. Lewis, President	20.00	
From balance in 1898	6.72	
	$1,059.97	$1,059.97
Total disbursements		975.20
Balance on hand		$84.77

The balance, $84.77, is now in the Fourth National Bank of Nashville, Tenn., subject to check or order of the Society.

Appended hereto is a schedule showing the sources from which all money for the year was received.

Vouchers, receipts, etc., for money paid out by the Treasurer during the year, are herewith presented. The salary of the Secretary, D. L. Fulton, for 1898, was paid on the authority of a letter of N. P. Lewis, President, dated September 15, 1899.

Respectfully submitted,

JOHN L. KENNEDY,
Treasurer, A. S. M. I.

October 3, 1899.

The sources from which the said money was derived are as follows, viz.:

1898.			
Oct. 26th..	Amount on hand as per Treasurer's report, approved by the Committee		$6.72
Nov. 4th...	From Secretary Fulton as per letter Nov. 1, 1898, sundry checks, viz.:		
	University of Illinois	$1.25	
	Capt. L. H. Beach	30.00	
	August Herrmann	50.00	
	Andrew Rosewater	3.00	
	W. N. Chancellor	30.00	
	John L. Kennedy	5.00	
	Wm. Leftwich, Jr	5.00	
	N. Y. draft for	182.00	
			$306.25
Dec. 5th...	From Secretary Fulton as per letter December, '98, sundry checks, viz.:		
	Check of D. L. Fulton	$50.00	
	David Folz Asphalt Co	7.00	
	A. N. Talbot	5.00	
	Hanover National Bank	2.00	
	S. E. Monroe	2.00	
	Edward B. Guthrie	5.00	
	Geo. L. Snyder	5.00	
	Horace Andrews	2.25	
	Fred Gittings	3.00	
	Robt. E. McMath	5.00	
	Bank of Hamilton	5.00	
	John F. Stark	5.00	
	Treasurer of Grand Rapids	10.00	
	Cornelius B. Gold	1.00	
	Treasurer Industrial University	1.00	

	Fred Gittings	2.00	
	Street and Sewer Dept., Wilmington, Del.	5.00	
	Allegheny money order	20.00	$135.25
Dec. 9th	From N. P. Lewis, President A. S. M. I. as per letter December 7, 1898, check for advertisement in report of Convention, from the Eastern Paving Brick Co.		20.00
1899.			
Feb. 8th	From Secretary Fulton as per letter February 6, 1899, sundry checks:		
	Check of M. L. Holman, St. Louis, Mo.	$5.00	
	Check of city of Newport, Ky.	6.00	
	Check of Jacob A. Harman, Peoria, Ill.	5.00	
	Forest City National Bank, N. Y., draft	3.25	
	Check of D. L. Fulton, Sec'y, Allegheny, Pa.	15.00	34.25
Mar. 15th	From Secretary Fulton as per letter March 13, 1899, sundry checks, viz.:		
	Compagnie Generale des Asphaltes de France, Ld., New York	$12.00	
	The Alcatraz Company, New York	20.00	
	Meacham & Wright, Chicago	12.00	
	Wm. Beckert, Allegheny	12.00	
	Mack Manufacturing Co., Pittsburg	20.00	
	N.Y. draft from G. H. Benzenberg, Milwaukee	12.00	88.00
Mar. 17th	From Secretary Fulton as per letter March 15, 1899, sundry checks, viz.:		
	The Fairbanks Co., New York	20.00	
	The Wilson & Baillie Mfg. Co., Brooklyn	20.00	
	The Barber Asphalt Paving Co., New York	12.00	
	Stowell & Cunningham, Albany, N. Y.	5.00	57.00
Mar. 20th	From Secretary Fulton as per letter March 17, 1899, check of August Herrmann		60.00
Apr. 11th	From Secretary Fulton as per letter April 7, 1899. sundry checks, viz.:		
	Warren-Scharf Asphalt Paving Co.	2.00	
	E. A. Fisher, City Engineer, Rochester, N. Y.	11.50	
	Municipal Engineering Co., Indianapolis	12.00	
	Buffalo Pitts Co., Buffalo, N. Y.	12.00	
	N. P. Lewis, C. E., Brooklyn, N. Y.	5.00	
		$42.50	
	Fisher check returned for endorsement	11.50	31.00

Apr. 17th..	From Secretary Fulton as per letter April 15, viz.:		
	W. C. Oastler	$20.00	
	Chas. L. Parmele, New York	2.25	
	Milwaukee Cement Co., Milwaukee, Wis.	20.00	
	N.Y. draft from E.W. Boynton, Davenport, Ia.	3.00	
	City warrant, city of Niagara Falls, N. Y.	2.00	
	City warrant, Grand Rapids, Mich.	1.00	
	Also, Fisher check returned	11.50	
			59.75
May 13th..	From Fulton, Secretary, as per letter May 11, 1899, sundry checks, viz.:		
	Denver Water Co., N. Y. draft April 15, 1899	$2.00	
	N. Y. draft from Buffalo, N. Y., April 28, 1899	20.00	
	Lawrence Cement Co., N. Y., April 27, 1899..	12.00	
	Western Paving Co., May 5, 1899	20.00	
	Engineering News Pub. Co., N. Y., May 3	12.00	
			66.00
May 15th..	From Fulton, Secretary, as per letter May 13, 1899, sundry checks, viz.:		
	Dept. Public Works, Buffalo	$6.00	
	N. Y. & Bermudez Co., N. Y.	20.00	
			26.00
July 22d...	From Fulton, Secretary, as per letter July 20, 1899, sundry checks, viz.:		
	Improved Street Sweeper Co., Pittsburg	$20.00	
	A. T. Byrne, Brooklyn	1.00	
	Columbia Construction Co., New York	20.00	
	Commercial Wood & Cement Co., Glens Falls	30.00	
	Assyrian Asphalt Co., Chicago	7.00	
			78.00
July 31st..	From Fulton, Secretary, as per letter July 28, 1899, sundry checks, viz.:		
	Sherrerd and French, Newark, N. J.		20.00
Aug. 21st..	From Fulton, Secretary, as per letter August 19, 1899, sundry checks, viz.:		
	A. P. Smith Mfg. Co., Newark, N. J.	$12.00	
	D. L. Fulton, Allegheny, Pa.	33.50	
	Geo. W. Tillson, Brooklyn, N. Y	6.25	
	W. K. Eldridge, Lafayette, Ind.	20.00	
			71.75
			$1,059.97

THE SECRETARY: These accounts for disbursements have all been approved by the President and Secretary, as provided by the Constitution, where they have not been ordered by the Society.

On motion, the report of the Treasurer was referred to the Finance Committee:

REPORT OF THE EXECUTIVE COMMITTEE.

THE PRESIDENT: The Executive Committee had a very brief session this morning and had one or two important matters to discuss, but did not get very far in the discussion. The Committee proposes to have an adjourned meeting at the close of this morning's session of the Convention, and I doubt, therefore, if the Committee can make a report at the present time. Would you suggest, Mr. Benzenberg, that any of the matters we were discussing be brought before the Convention now?

MR. BENZENBERG: I would suggest that you outline to the members what has been under discussion and consideration by the Executive Committee, so that they may think over the matter and be able to discuss and take action upon it later. I think that all should give the subject some thought and have an opportunity to discuss it.

THE PRESIDENT: If you wish me to make a statement, I will do so. The subject which Mr. Benzenberg refers to is one which has been considered by the members of the Executive Committee during the past year, and it is as to the advisability of giving out advance copies of papers prepared for these conventions before the publication of our proceedings—whether or not requests by representatives of technical journals or papers for such papers should be acceeded to by the Committee presenting them, or by any officer of our Society. You are all aware that under the Constitution (Section 4, Article 7), "All papers, drawings and so forth * * * * * shall be and remain the property of the Society." The question was raised during the past year, whether it would not be wise to copyright our reports. If this were done, of course the giving out of advance copies of papers would be prohibited. I certainly believe that the indiscriminate publication of these papers should be stopped, and that if any journal wants to print them it should make application to the Society through its proper officers; and the Society can then do as it pleases. A definite line of policy should be settled by this Convention.

The question is, would it make our reports of more value to have them copyrighted? Would they be sought after if they were not quite so easy to get? Or would it pay us better to give our papers as broad a circulation as possible? Of course, we do not like to feel that we are furnishing material to fill two or three magazines gratuitously for a month or two with interesting and useful reading matter. It seems hardly fair that we should do so, especially (as I have known to be the case) where these papers have been printed without the slightest acknowledgment. In my opinion, any journal which would do this should never be furnished with another paper by this Society.

This is the question to which Mr. Benzenberg refers, and which the Committee has been considering and on which it will probably make some recommendation. I hope you will give the matter careful thought, and, when the question comes before us in Convention, be prepared to decide upon our future policy.

Another question is that of advertising our Conventions and increasing our membership. Any suggestions or any inspirations from any member of the Society will certainly be very acceptable to the Executive Committee.

SELECTION OF COMMITTEE ON NOMINATIONS OF OFFICERS AND NEXT PLACE OF MEETING.

The President: It has occurred to me that, as a good many of the delegates that will no doubt arrive cannot be present with us this morning, it would be well to wait till we have a little larger representation before we select these important committees. However, I will abide by the printed program, unless the members desire otherwise. I would like to have an expression of opinion from the members of the Convention. There are two committees, composed each of five members, which under our order of business were to have been selected this morning. In the past they have been selected in the evening, but it was thought wise to put this order of business on the morning program, instead of a paper, in order to give the Committee a little more time and to get the business out of the way. Under the circumstances, it might be well to postpone the selection of the committees till this afternoon or evening.

Moved and seconded, that the selection of the committees on nominations of officers and next place of meeting be made the first order of business for this evening's session. Carried.

THE PRESIDENT: You have noticed by the program that to-morrow morning was to be given up to a ride about the city and suburbs, in private cars furnished through the courtesy of the Toronto Railway Company, of which Mr. E. H. Keating is Manager. I am requested to state that the time fixed for the starting of these cars is 10 o'clock to-morrow morning. The cars will start from the side-track in front of the Union Station, on Front Street; it will be necessary to start promptly, and the members are requested to be on hand at 10 o'clock sharp. The ladies will, of course, be expected to accompany us, and we hope they will all do so.

Alderman Saunders wishes me to state that the City Hall, between 7 and 8 o'clock this evening, will be opened and lighted throughout all the corridors, affording an excellent opportunity for the inspection of the building. This does not, of course, include the offices, which are open to the public at all times through the day, from 9 a. m. till 4:30 p. m. The Council of the city will be very glad to have us go through the building and see the municipal home of which Toronto is so justly proud.

On motion, the meeting adjourned to meet at 2 o'clock p. m.

TUESDAY, OCTOBER 3d, 1899—AFTERNOON.

The President, in the chair, called the meeting to order.

THE PRESIDENT: We cannot wait longer for our 2 o'clock delegates, but will proceed with the regular order of business for th afternoon. The first report on the program is that of the Committee on Electric Street Lighting, by Mr. David Hunter, Superintendent of the Allegheny Electric Light Plant of Allegheny, Pa. Mr. Hunter is not present, but the Secretary has Mr. Hunter's report, which he will now read to you.

The Secretary read the report of the Committee on Electric Street Lighting, as follows:

REPORT OF THE COMMITTEE ON ELECTRIC STREET LIGHTING.

TORONTO, CANADA, OCTOBER 3, 1899.

TO THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS:

GENTLEMEN:

Your Committee on Electric Street Lighting begs your indulgence in offering its report, which might have been of much greater interest and importance, but, owing to tardiness on the part of the Chairman, the following is the best it has to offer.

Your Committee desires to call your attention to what it considers more or less improper methods prevailing in the matter of contracts existing between municipalities and lighting companies for the lighting of the public highways by means of the electric arc lamp.

The existing form of contract calls for a certain type of lamp, commercially known as being capable of rendering 1,200 or 2,000 candle power, using power to the amount of 330 and 480 watts respectively, operating under normal conditions, and for which the municipality agrees to pay a fixed price per lamp per annum, same to be in service a fixed number of hours.

With the above form of contract it is possible, and in many cases probable, that the current furnished to lamps will be very much reduced, the company thereby economizing in fuel, carbons and apparatus, while the municipality suffers a corresponding loss in illumination. and, as a natural consequence, complaints come from the public to the city officials, claiming the light is poor and it is not getting what it pays for.

Another matter requiring some attention is that of the adjustment of outages. In the present form of contract it is customary for the company to allow a rebate (corresponding to the contract price) for all lamps not burning. This has the appearance of being fair to all concerned, but many outages occur that escape the notice of the municipal officials, even under the most rigid methods of inspection, and all such leaks must be borne by the municipality.

Your Committee is of the opinion that the troubles mentioned may be removed entirely by the adoption of the meter system, under which you will pay only for current used. The contracting company, being in the business to sell current, will then find it to its interest to maintain normal current on its street lighting circuits and take better care of lamps, in order to reduce outage account.

The best service within the power of the company to render will then be obtained by the municipality, with but slight effort on the part of the latter.

With the adoption of the meter system it would be necessary for the representative of the municipality to have access to the meters operating in street lighting circuits, enabling him to take two daily readings of each street lighting circuit watt meter—one reading previous to lights on, and one at the time lights are cut off.

Knowing the number of lamps on each circuit, and wattage of same, daily comparisons should be made between meter readings and approximately known circuit wattage, and it will then be possible to discover at once any considerable error in meter and have same rectified immediately. In making above comparisons it is of course understood that allowance must be made for line resistance, making, say, two miles of circuit of average construction the equivalent of one arc lamp. In other words, a circuit ten miles long, operating 60 arc lamps, may be computed for wattage as having 65 lamps in circuit. In ordinary practice the above will be found approximately correct.

All meters should be calibrated monthly.

All other details in contracts may remain as at present, including that of rebate for outages, except that the contract might concede a fixed percentage of same; and anything above that should be charged against the company at such rate as may be determined in contract, provided all such excess outages might have been prevented by the exercise of proper care.

The meter system will necessitate closer observance in the matter of supervising the lighting of the city, as it will prohibit the joint operation of public and commercial circuits.*

A question naturally arising in the event of the adoption of the meter system is that of price per Kilowatt hour for current used under existing service. It would probably be as well to leave this unanswered, knowing as we do that local influences and conditions control these matters, as may be seen by referring to tabulations embodied in this report. However, comparison may be made as follows: An arc lamp using 9.6 ampere current at 50 volts (2,000-candle power so called) consumes power at the rate of .480 Kilowatts for which the average cost is 2.81 cents per lamp hour as per tabulation of 78 cities under contract, or at the rate of 5.85 cents per Kilowatt hour.

Average cost per 2,000-candle power lamp hour, computed from 25 electric plants owned and operated by municipalities, is 2.71 cents, being equivalent to 4.51 cents per Kilowatt hour. Interest, depreciation and insurance are included in municipal plant cost of service.

To those desiring to make detailed investigation of the cost of electric plants, and service from same, the accompanying reports of the cities of Detroit and Allegheny may be found valuable.

For statistics on cost of street lighting your Committee beg leave to submit the following bulletin, compiled by the League of American Municipalities, and issued by the City Government Publishing Co. of New York.

The bulletin is of recent date and portrays the question in admirable manner.

STATISTICS ON STREET LIGHTING BY ELECTRICITY.

The Bureau of information of the League of American Municipalities is now engaged in gathering facts regarding the cost of electric, gas and naphtha street lighting. From returns already in, the truth of which is vouched for by the officials of the various cities reported, the accompanying statistical tables on cost of electric street lighting have been compiled. A total of 107 contracts, representing 105 cities and twenty-five municipal electric plants, are represented in these tables.

The first table shows twenty-nine contracts for 1,200-candle power lights, and it is published merely for the purpose of drawing a comparison between the cost of 1,200 and 2,000-candle power lights. It is shown that the average price per lamp hour of 1,200-candle power lights is 2.73 cents, while the average price per lamp hour of 2,000-candle power lights is 2.81 cents—a difference of only eight one-hundredths (.08) of a cent.

Passing on to the second table, we find statistics on contracts for 2,000-candle power lights from seventy-six cities, situated in all sections of the country. Des Moines, Ia., and Minneapolis, Minn., each present two contracts, one for all-night lighting and the other for the shorter schedule. In both of these cities, it will be observed, the cost of lights on the all-night schedule is nine-tenths (.9) of a cent per hour less than that of lights burned but 2,250 hours a year.

For the convenience of those who desire to study comparisons, the seventy-eight contracts have been arranged, according to cost per lamp hour, in six groups. All those showing a cost per lamp hour of less than 1.5 cents are placed in group No. 1; from 1.50 to 2 cents per hour in group No. 2; from 2 to 2.5 cents per hour in group No. 3; from 2.5 to 3 cents per hour in group No. 4; from 3 to 3.5 cents per hour in group No. 5, and over 3.5 cents per hour in group No. 6.

As 2.81 cents is the average price per lamp hour of the seventy-eight contracts, group No. 4 (from 2.5 to 3 cents) is taken as the average group. Now, as to the life of contract, which is said to have some bearing on the price, we find fourteen cities with contracts expired or without time limit; fourteen contracts for one year; three for two years; ten for three years; twenty-four for five years; one for nine years, nine for ten years; one for twenty years, and two for twenty-five years. Relating to prices, three of the one-year contracts are in the average group, four below and seven above the average; two of the two-year contracts are in the average group and the other below the average; one of the three-year contracts is in the average group, five below and four above; four of the five-year contracts are in the average group, twelve below and eight above; the nine-year contract is above the average; two of the ten-year contracts are in the average group, two below and five above; the twenty-year contract is above the average; one of the twenty-five year contracts is in the average group and the other below. Looking at this item in another way, we find 50 per cent. of the one-year contracts, 40 per cent. of the three-year contracts, 33⅓ per cent. of the five-year contracts, 55 per cent. of the ten-year contracts and 100 per cent. of the twenty-year contracts above the average price.

These statistics cannot be made to snow that the number of lights supplied under each contract has anything to do with making the price. For instance, Providence, with 1,891 lights, pays 3.19 cents per lamp hour, while Newark, with nearly as many lights, pays but 2.45 cents. Baltimore, with 1,369 lights, pays 3.19 cents, while Buffalo, with 2,550 lights, pays only 2.53 cents. Brattleboro, Vt., with 49 lights, pays 4.5 cents, while Easton, Pa., with 41 lights, pays only 1.3 cents. Comparisons like these may be drawn from the table indefinitely. Louisville, Newark, Buffalo, Baltimore, New Orleans and Providence, each of which has 1,000 lights, pay more per lamp hour than their respective neighbors. Owensboro, Easton, Olean, Allentown, Natchez and Worcester, with an average of less than 200 lights each.

The difference in the cost of coal at various points accounts in a way for the disparity in the prices of lights, yet it does not furnish a satisfactory accounting. Lima and Sandusky, neighboring cities, with the price of coal about the same, and with about the same number of lights, pay 4 cents and 2.18 cents, respectively, per lamp hour for electricity. Belfast and Auburn, Me., furnish another such example, and still others may be picked out from the table. Why should Providence, with coal at $4 and with over 1,600 lights, pay 3.19 cents per lamp hour, while Rutland, Vt., with coal at $4.50 and with only 125 lights, pays but 2.40 cents per lamp hour? These statistics will call forth many such questions as that.

The table showing statistics from twenty-five representative municipal electric plants, none of which does commercial business, is well worth studying in comparison with the contract lighting figures given in the other tables. It is shown that the cost of 2,000-candle power lamps under municipal ownership in twenty-five cities averages 2.17 cents per lamp per hour.

NO. 1.

Arc Electric Street Lights—1,200 Candle Power—Contract Prices.

CITY.	Life of Contract.	No. of Lamps.	Hours per Year.	Per Year.	Per Hour Cents.
Anniston, Ala	2	55	2,250	$75.00	3.33
Amsterdam, N. Y	5	154	3,800	94.50	2.48
Beverly, Mass	5	175	3,800	109.50	2.88
Cambridge, Mass	1	514	3,900	100.00	2.56
Charleston, S. C	0	112	2,179	100.00	4.58
Charleston, W. Va	1	86	2,250	72.00	3.20
Chillicothe, O	10	177	3,800	65.00	1.71
Circleville, O	10	121	2,700	75.00	2.77
Chelsea, Mass	5	200	3,800	104.98	2.76
Dover, N. H	5	130	2,000	67.00	3.35
Elmira, N. Y	5	300	3,800	80.00	2.10
Fort Madison, Ia	0	87	2,250	67.50	3.00
Fitchburg, Mass	3	256	3,800	110.00	2.89
Gloversville, N. Y	5	118	3,800	92.59	2.43
Hartford, Conn	4	715	3,960	75.24	1.90
Holyoke, Mass	0	254	3,800	100.00	2.63
Janesville, Wis	3	156	3,800	65.00	1.73
Kingston, N. Y	3	105	3,800	85.00	2.23
Kearney, Neb	0	11	3,800	106.20	2.79
Lafayette, Ind	5	285	2,200	66.00	3.00
Madison, Wis	5	123	3,263	60.00	1.83
Milford, Mass	2	46	2,365	100.00	4.22
New Haven, Conn	3	472	4,000	91.25	2.28
Newburg, N. Y	1	274	3,800	96.22	2.53
Newton, Mass	3	188	3,360	100.00	2.97
Norfolk, Va	3	280	3,650	85.00	2.32
New London, Conn	1	101	3,650	100.00	2.73
Savannah, Ga	5	502	3,650	72.00	1.97
Stillwater, Minn	0	16	2,250	96.00	4.26

Total, 29 contracts; average price per lamp per hour, 2.73 cents.

NO. II.

Arc Electric Street Lighting—2,000 Candle Power—Contract Prices.

CITY.	Life of Contract.	No. of Lamps.	Hours per Year.	Per Year.	Per Hour Cents.
Atlanta, Ga	5	632	3,800	$85.00	2.23
Allentown, Pa	1	142	3,800	100.00	2.63
Asheville, N. C	1	96	3,800	85.00	2.23
Auburn, Me	5	86	3,432	50.00	1.45
Baltimore, Md	5	1,369	4,000	127.75	3.19
Buffalo, N. Y	5	2,550	3,948	100.00	2.53
Butte, Mont	3	133	3,800	144.00	3.78
Belleville, Ill	3	150	2,260	75.00	3.32
Brattleboro, Vt	0	49	2,000	90.00	4.50
Boone, Ia	1	34	3,000	90.00	3.00
Belfast, Me	0	26	1,800	76.65	4.25
Chicago, Ill	1	531	3,800	103.00	2.71
Columbus, Ga	1	120	2,182	85.00	3.89
Denver, Col	0	950	3,800	100.00	2.63
Des Moines, Ia	0	183	3,800	75.00	1.97
Davenport, Ia	25	422	2,200	56.00	2.54
Des Moines, Ia	0	129	2,250	65.00	2.88
Easton, Pa	1	41	3,800	49.50	1.30
E. St. Louis, Mo	10	144	3,800	100.00	2.63
Fort Wayne, Ind	5	260	2,250	100.00	4.44
Fort Smith, Ark	10	100	2,250	80.00	3.55
Faribault, Minn	5	44	2,000	51.00	2.55
Grand Rapids, Mich	0	409	3,800	90.00	2.36
Galesburg, Ill	1	175	2,250	75.42	3.35
Gainesville, Tex	5	30	3,000	90.00	3.00
Hot Springs, Ark	10	32	3,800	180.00	4.73
Hopkinsville, Ky	0	40	3,800	92.10	2.42
Hutchinson, Kan	10	34	2,500	100.00	4.00
Haverhill, Mass	1	191	3,800	125.00	3.28
Iowa City, Ia	5	100	2,700	72.50	2.68
Joplin, Mo	5	60	3,800	72.00	1.89
Kansas City, Mo	0	190	3,800	110.00	2.89
Kenosha, Wis	10	107	2,250	78.00	3.44
Keokuk, Ia	5	143	2,250	75.00	3.33
Louisville, Ky	5	1,454	3,760	84.00	2.23
Lowell, Mass	5	469	3,650	120.45	3.30
Lockport, N. Y	2	255	3,800	78.00	2.05
Lawrence, Mass	3	222	2,000	90.00	4.50

CITY.	Life of Contract.	No. of Lamps.	Hours per Year.	Per Year.	Per Hour Cents.
Lima, O.	9	171	2,250	90.00	4.00
Leadville, Col.	0	40	3,800	162.00	4.26
Minneapolis, Minn.	1	637	2,250	90.00	4.00
Minneapolis, Minn.	1	164	3,500	108.50	3.10
Memphis, Tenn.	5	267	3,800	85.00	2.23
Mobile, Ala.	5	206	3,800	88.00	2.31
Mankato, Minn.	5	55	2,250	74.00	3.28
Menominee, Mich.	0	68	2,250	58.82	2.61
Massillon, O.	0	125	2,000	65.00	3.25
New Orleans, La.	10	1,623	4,000	127.50	3.19
Newark, N. J.	0	1,653	4,010	98.55	2.45
Nashville, Tenn.	10	382	3,800	85.00	2.23
Natchez, Miss.	10	100	3,800	103.00	2.71
Omaha, Neb.	5	333	4,000	114.50	2.86
Oswego, N. Y.	5	229	3,800	81.00	2.13
Oil City, Pa.	10	106	3,650	80.00	2.19
Olean, N. Y.	5	65	4,000	85.00	2.12
Owensboro, Ky.	3	100	3,800	72.50	1.90
Oskaloosa, Ia.	5	25	2,655	96.00	3.61
Providence, R. I.	20	1,891	4,000	127.75	3.19
Peoria, Ill.	2	436	3,800	98.00	2.57
Parkersburg, W. Va.	0	115	4,053	87.50	2.15
Pana, Ill.	3	81	3,800	78.00	2.05
Phoenixville, Pa.	5	27	3,800	90.00	2.36
Parsons, Kan.	3	51	4,276	84.00	1.96
Roanoke, Va.	3	140	4,380	76.65	1.75
Richmond, Ind.	25	181	3,900	90.00	2.30
Rutland, Vt.	0	125	3,800	91.25	2.40
St. Paul, Minn.	1	257	4,000	93.63	2.34
Salt Lake City, Utah.	3	401	3,800	72.00	1.89
Sacramento, Cal.	1	330	3,285	123.00	3.74
Spokane, Wash.	5	200	3,800	48.00	1.26
San Antonio, Tex.	5	150	2,250	90.00	4.00
Schenectady, N. Y.	1	203	4,000	103.00	2.57
Salem, Mass.	3	180	3,864	130.00	3.36
Sandusky, O.	5	165	4,000	87.50	2.18
St. Cloud, Minn.	1	41	3,800	75.00	1.97
Somerville, Mass.	2	361	3,828	110.00	2.87
Terre Haute, Ind.	5	450	3,800	63.95	1.68
Worcester, Mass.	3	610	3,900	116.80	2.99

Total, 78 contracts; average price per lamp, per hour, 2.81 cents.

NO. III.

Municipal Plants—2,000 Candle Power Lamps.

(Five per cent. for interest and 4 per cent. for depreciation allowed in every case in calculating cost per lamp.)

CITY.	No. of Lamps.	Hours per Year.	Cost per Year.	Cost per Hour.
Allegheny, Pa	1,237	3,976	$72.34	1.81
Aurora, Ill	206	2,527	64.55	2.55
Bay City, Mich	209	2,623	53.25	2.03
Batavia, N. Y	103	3,407	65.22	1.91
Bloomington, Ill	310	2,713	74.33	2.74
Columbus, Ind	82	2,200	58.08	2.64
Detroit, Mich	1,882	3,786	79.65	2.10
Decatur, Ill	156	2,179	48.40	2.22
Dunkirk, N. Y	75	2,809	63.33	2.25
Easton, Pa	141	3,833	93.75	2.44
Galveston, Tex	300	3,000	82.93	2.76
Goshen, Ind	125	2,400	48.26	2.01
Kalamazoo, Mich	200	3,036	83.29	2.74
Little Rock, Ark	212	2,453	50.28	2.04
Marion, Ind	118	2,200	53.95	2.45
Meadville, Pa	109	3,500	66.98	1.91
Newark, O	226	3,285	48.54	1.47
Paducah, Ky	120	4,000	71.09	1.77
Rochelle, Ill	40	2,179	55.22	2.53
St. Joseph, Mo	369	2,700	63.79	2.35
St. Charles, Mo	80	2,920	73.13	2.50
Sherman, Tex	64	4,015	68.00	1.69
Topeka, Kan	264	2,195	57.91	2.63
Titusville, Pa	114	4,000	57.94	1.44
Wheeling, W. Va	450	4,000	67.00	1.67

Total, 25 plants; average cost per lamp per hour, 2.17 cents.

GROUP NO. 1—Three Cities.

Below 1.5 Cents per Lamp Hour.

	Life of Contract.	No. of Lamps.	Coal per Ton.
Auburn, Me	5	86	$4.00
Easton, Pa	1	41	2.85
Spokane, Wash	5	200	1.50

GROUP NO. 2—Nine Cities.

Between 1.5 and 2 Cents per Lamp Hour.

	Life of Contract.	No. of Lamps.	Coal per Ton.
Des Moines, Ia	0	129	$1.00
Joplin, Mo	5	60	1.00
Owensboro, Ky	3	100	2.25
Parsons, Kan	3	51	2.30
Roanoke, Va	3	140	2.75
Salt Lake City, Utah	3	401	3.75
St. Cloud, Minn	1	41	3.25
Terre Haute, Ind	5	450	.75

GROUP NO. 3—.. Cities.

Between 2 and 2.5 Cents per Lamp Hour.

	Life of Contract.	No. of Lamps.	Coal per Ton.
Atlanta, Ga	5	632	$1.10
Ashville, Ga	1	96	3.00
Des Moines, Ia	0	183	1.00
Grand Rapids, Mich	0	409	2.60
Hopkinsville, Ky	0	40	1.85
Louisville, Ky	5	1,454	1.00
Lockport, N. Y	2	255	2.00
Memphis, Tenn	5	267	1.75
Mobile, Ala	5	206	2.70
Newark, N. J	0	1,653	1.70
Nashville, Tenn	10	382	2.10
Oswego, N. Y	5	229	3.00
Oil City, Pa	10	106	1.00
Olean, N. Y	5	65	2.25
Parkersburg, W. Va	0	115	1.15
Pana, Ill	3	81	1.00
Phoenixville, Pa	5	27	2.00
Richmond, Ind	25	181	2.10
Rutland, Vt	0	125	4.50
St. Paul, Minn	1	257	3.25
Sandusky, O	5	165	1.65

GROUP NO. 4.

Between 2.5 and 3 Cents per Lamp Hour.

	Life of Contract.	No. of Lamps.	Coal per Ton.
Allentown, Pa	1	142	$2.60
Buffalo, N. Y	5	2,550	2.00
Chicago, Ill	1	531	2.00
Denver, Col	0	950	2.15
Davenport, Ia	25	422	1.35
East St. Louis, Mo	10	144	1.25
Faribault, Minn	5	44	3.00
Iowa City, Ia	5	100	1.00
Kansas City, Mo	0	190	2.00
Menominee, Mich	0	68	3.25
Natchez, Miss	10	100	2.00
Omaha, Neb	5	333	1.90
Peoria, Ill	2	436	1.25
Schenectady, N. Y	1	203	3.00
Somerville, Mass	2	361	4.15
Worcester, Mass	3	610	4.45

GROUP NO. 5.

Between 3 and 3.5 Cents per Lamp Hour.

	Life of Contract.	No. of Lamps.	Coal per Ton.
Baltimore, Md	5	1,369	$3.00
Belleville, Ill	3	150	.65
Boone, Ia	1	34	1.75
Galesburg, Ill	1	175	2.00
Gainesville, Tex	5	30	3.00
Haverhill, Mass	1	191	4.75
Kenosha, Wis	10	107	2.25
Keokuk, Ia	5	143	2.00
Lowell, Mass	5	469	4.25
Minneapolis, Minn	1	164	3.25
Mankato, Minn	5	55	4.00
Massillon, O	0	125	1.50
New Orleans, La	10	1,623	3.00
Providence, R. I	20	1,891	4.00
Salem, Mass	3	180	4.10

GROUP NO. 6.

Over 3.5 Cents per Lamp Hour.

	Life of Contract.	No. of Lamps.	Coal per Ton.
Butte, Mont	3	133	$3.75
Brattleboro, Vt	0	49	4.85
Belfast, Me	0	26	4.00
Columbus, Ga	1	120	2.00
Ft. Wayne, Ind	5	260	2.00
Fort Smith, Ark	10	100	1.60
Hot Springs, Ark	10	32	2.50
Hutchinson, Kan	10	34	2.50
Lawrence, Mass	3	122	4.00
Lima, O	9	171	1.75
Leadville, Col	0	40	3.50
Minneapolis, Minn	1	637	3.25
Okaloosa, Ia	5	25	1.00
Sacramento, Cal	1	330	6.00
San Antonio, Tex	5	150	2.50

THE PRESIDENT: Is there anything else to be said on this subject of electric street lighting? I know of no other papers which have been prepared on the subject; and if any gentleman has any suggestions to offer or any questions to ask, he may do so now.

Have not some of our Toronto members anything to say on the subject of electric street lighting?

MR. JOHN JONES, Street Commissioner, Toronto: From the reading of the report it would appear to me that the figures are all compiled from the records of plants where electricity is generated by steam. Are there any figures taken from records of electricity generated by water power?

THE SECRETARY: There is nothing said in the report to indicate to me that water power has been taken into consideration in it, because in the tables the writer gives the price of coal all through.

MR. JONES, Toronto: It is on that account that I thought the paper read referred to electricity generated by steam. What is the price paid for coal?

THE SECRETARY: It runs from 65 cents to $4 a ton for coal, in different places; he gives the price per ton in each city, the number of lamps and the life of the contract, and the hours that they are supposed to run, ranging from 2,250 hours to 4,000 hours a year.

MR. JONES, Toronto: I would like to ask the Secretary, if Buffalo is included in the compiled figures, because I understand that the Buffalo electric light is produced chiefly from water power.

THE SECRETARY: Yes, he has Buffalo here; he has coal at $2 a ton in Buffalo.

MR. C. H. RUST, City Engineer, Toronto: I do not think they get their electricity in Buffalo for lighting by water power; I think the water power is only used for generating electricity for the street railway.

MR. JONES, Toronto: What is their contract?

THE SECRETARY: They have a contract for five years, 2,550 lamps, $100 per lamp—two and fifty-three one-hundredths cents per hour.

THE PRESIDENT: That is about the average; a trifle under, perhaps. Is Niagara Falls given?

THE SECRETARY: No, sir; Niagara Falls does not appear in the report at all.

THE PRESIDENT: Mr. Keating is making a good deal of electricity these days; I will ask Mr. Keating whether he supplies any power for lighting.

E. H. KEATING, Manager Toronto Railway Company: No, except on a limited scale.

THE PRESIDENT: Has anyone else anything to offer on the subject of electric lighting? If not, we will pass to the subject of sewerage and sanitation. The report of the Committee is scheduled to be presented by the Chairman, Captain Beach, but, unfortunately, Mr. Beach is not here, and his absence appears to be unavoidable; however, we have Mr. Ball, a representative from Washington, who, I understand, has a paper on one phase of this subject which we will be glad to hear.

Mr. Ball, Washington: Mr. President and Gentlemen, one owes an apology for taking up the time of the Convention on a subject which most engineers consider to have been thoroughly settled; and yet, it is one of those things which periodically comes to the surface and will not "down." Therefore it is, possibly, justifiable to express a few suggestions on a question interesting both to the sewer engineer and the gentlemen who design plumbing; and in that connection I may say that for the last five years I have been associated with house plumbing matters.

IS A HOUSE SEWER TRAP ALWAYS NECESSARY?

MR. BALL, WASHINGTON, D. C.

The writers who have in recent years discussed drainage and sewerage questions concur in the opinion that liquid domestic wastes must be conducted as speedily as possible from the plumbing fixtures through the house drains and the lateral and main sewers, to the outfall of the system.

In order to accomplish this desirable result, the ideal sewage conduit is supposed to have a smooth and impervious surface, few and thin joints, sufficient and uniform gradients, good alignment with easy curves, a size not excessive in its relation to the work performed, and to be provided with efficient means of ventilation.

Those engineers who are practiced in the construction of drainage works realize that these conditions are usually, but imperfectly, fulfilled, yet the desirability of approximating to them as closely as may be is not questioned.

Admitting the validity of these fundamentals of design and comparing approved practice with such standards, we observe at once an anomalous circumstance in the presence in each house sewer line of an intercepting trap, which destroys the ideal conditions by disturbing the course of stream flow, decreasing its velocity, hastening the deposit of suspended matters, and preventing a general circulation of air through the sewers and house drains.

Frequent objection is made to this appurtenance by the intelligent plumber, who finds it often obstructed; by the skillful architect, who is unable to fix upon a suitable location for the required air inlet, and by the sewer engineer, who notes with a jealous eye the open ends of hundreds of house soil pipes, rendered unavailable, by the prescribed construction, for the ventilation of the public system.

While the present writer must not be understood as advocating the universal abolition of the main trap, it is his object to determine more fully the grounds on which it is stated to be a necessity and to inquire if the omission of this appliance may not sometimes be safely accomplished.

The use of an intercepting trap is based upon the assumption that it is necessary to prevent the intrusion of air from the public sewers to the house piping system, and that varying air pressures must necessarily occur in the sewers, which will, if freely admitted to the house lines, endanger the trap seals of plumbing fixtures. While it is unquestionable that the displacement of the air contained in public sewers by the sudden entrance of storm water is very rapid, and that compression is likely to prevail, it would seem that the most ready means of avoiding damage to the house traps would be to provide ample means for the escape of air at many points, as would be the case were every house trap omitted, rather than to convert the main sewer into a sealed chamber, the air pressure in which must sometimes be sufficient to force the main trap seals. The serious objections to numerous and adequate openings from the public sewers at the street level are well recognized, and such a means of securing free communication between street sewers and the outer air has been but rarely supplied.

A second objection to the omission of traps arises from the fear that the obstructing foreign matters now retained by the house trap would otherwise pass to the public sewers and cause stoppages therein. This is a real objection, especially where the separate system is in vogue, but, from the point of view of most sewer designers, would be more than compensated for by the full ventilation of the public system, which would take place if traps were not required.

A third and principal reason for the retention of house traps is that disease germs may be communicated through the main sewer from an infested house sewer to other house lines. We agree with a recent writer that "the air in sewers may at times be charged with malignant germs of disease," and that the "ventilation of the public system should be affected where the air would be least liable to be inhaled by the public." Is it not true that the least dangerous point for the discharge of such germs is above the house top and not at the ground level?

No authoritative statement as to how far dangers of this nature are real can be made without close observation of the operation and effect upon the public health of systems in which house traps have not been used. Notable examples of this class are found in the towns of

Davenport, Ia., Corning, N. Y., and Newton, Mass. So far as I have been able to learn, no objection is made practically to the operation of the drainage equipment in these towns.

The main and recurring objection is to present practice, the closing of the main sewer, and, in many cases, of a considerable portion of the house drain to the most direct and available means for thorough ventilation.

It may be noted that the objection to open connections with the sewers has little force if the plumbing within each house thus connected has tight joints. The present methods of inspections and tests of new plumbing work assure this result in most cities. At all events, the integrity of the plumbing should be above suspicion, whether main traps are provided or not. If the houses are constructed of uniform height, as is usually the case in modern city blocks, or, if they are isolated from each other, as in suburban localities, emanations from the soil pipe openings cannot injuriously affect the occupants of neighboring premises.

In two outlying districts of the city of Washington the concurrence of three conditions, viz., new and clean sewers, recently constructed house plumbing, and the separated locations of the dwellings, has been thought to justify the omission of the house running traps.

That even more radical opinions than those here expressed are entertained by eminent sanitary authorities is evidenced in a report to the Sewerage Commission of the city of Baltimore, rendered in November, 1896, by Messrs. Rudolph Hering and Samuel M. Gray, from which I quote

"The problem of sewer ventilation * * * * * resolves itself into a "provision for maintaining a direct communication between the air in "the sewers and the atmosphere, and in causing the entrance of pure "air, and its circulation through the sewers, to be as free as practicable.

"The most perfect way of accomplishing the above conditions is to "ventilate the public sewers through the house drains and soil pipes "of the buildings, to omit a main trap along the house sewer, which also "acts as a retainer of foul matter, and to have perforations in the "man-hole covers of the public sewers. In this way an abundance of "air can enter the system, not only from the outfall, but through the "man-hole covers, and circulate through the sewers and out through "every private sewer to above the roofs of the buildings.

"Such a method of ventilation, however, requires that the entire "plumbing in the house is planned and constructed by responsible "parties, so that the work will be first-class. It is also necessary to have "the house pipes tested after the plumbing is finished so as to be "assured of tight joints.

"This method has been tried in several cities in our country, and "is the common one of the Continent of Europe; but it is not the usual "one in our country, for there is in the minds of many a fear that if "the public sewer should be ventilated through the soil pipe of the "house, some danger might arise, through a leak in their own pipes, "of contracting a disease, the germs of which are supposed to come "from the public sewer.

"From experience in our country and in Europe, these fears are "not well founded, and there are *no facts on record to justify them.* On "the other hand, the advantages of a thorough draft through the house "pipes is considerable and keeps them much cleaner than where a trap "is placed between the house and the sewer, thus disconnecting the two.

"It has been said that air coming out of soil pipes below windows "of adjoining houses might cause offense. But offense could also be "caused if there were a main trap and the house pipes were fouled, "which they generally are not when used for ventilating the public "sewers."

THE PRESIDENT: Are there any other papers on this subject? If not, this one is open for discussion.

MR. ADAM, City Engineer, Newark, N. J.: I would like to ask the question whether that paper pertains only to the separate system of sewerage, or does it cover the combined system as well?

MR. BALL, Washington: I stated that possibly the difficulties were somewhat greater in the case of the separate system, due to the fact that foreign matters inadvertently admitted to the house plumbing would probably cause more damage in the separate system than in the large sewers of the combined system. I think that is the whole question of disadvantage.

MR. ADAM: More likely to do damage in sewers of large size——

MR. BALL, Washington: That is a much disputed point; I would say the objection would be on the other system.

MR. THOMPSON, Peoria: Sewer ventilation is a problem that municipal engineers of America have hardly studied sufficiently to be thoroughly posted on the subject. But it is becoming of such importance that it will reauire some solution in the near future. In England more attenton has probably been given to this one phase of the sewer question than in any other country, and they have there tried all forms of ventilation, including shafts with heat at the bottom, shafts without fire in them, ventilation through the soil pipes of the houses, and ventilation through open storm water inlets. The ordinary method has been to secure ventilation by openings at the surface of the streets, which becomes at times very offensive, even if it is not unhealthy. Mr. Mawbey, of Leicester, England, has recently made a report to his superiors, wherein he gives a full account of the methods tried in that city, from which he concludes the most effective and satisfactory system is by means of numerous small shafts attached to the outside of buildings and connected with the sewer.

MR. RUST, City Engineer, Toronto: We have made several attempts to ventilate sewers by means of a pipe running up the side of the building. The difficulty is to get the owner's permission to do the work. Except in two cases, they have always objected to pipes running up their buildings.

I noticed in Liverpool that it is the method they have adopted there, and when I was over there last I got a sketch of their method of piping and tried to introduce the same here; but, as I say, the difficulty was to get the property owner's consent. I think that that system is really the proper one for ventilating sewers in crowded districts. We have several complaints, especially at this time of the year, of the offensive odors which are noticeable on our streets.

THE PRESIDENT: Mr. McMath, haven't you something to say on this subject, or some kindred subject.

MR. MCMATH, President Public Improvements, St. Louis, Mo.: I do not know that I have anything I can say on this subject. I was formerly intimately connected with sewer construction, but for the last eight years I have had little or nothing to do with it, and I have become as rusty as a man could be on the special matter of sewer operation.

MR. GEORGE H. BENZENBERG, Consulting Engineer, Milwaukee, Wis.: I have not much to say on this subject, although I can not quite reconcile myself to the idea of doing away with the main trap between the sewer and the house. It seems to me it is opening too easy an avenue for gases, which undoubtedly accumulate in main sewers, to enter through some fixture which is not in repair, or through the trap of some fixture which has not been in use for some time and of which the seal has been broken by evaporation. In a few instances in Milwaukee connections have been made with the house service drain between the main trap and the main sewer, thus leading the gases upward through a pipe alongside the building and leaving the main trap in position. I am satisfied that some attention must be given to this subject in the larger cities. The method of ventilating main sewers through catch-basins at the corners, or occasionally through perforated man-hole covers, is objectionable. The odor escaping becomes at times exceedingly offenive and is noticeable for a long distance. In the city of Milwaukee one of the largest distilleries has connected an overflow with the lower end of a very large sewer. On the line of the overflow a precipitation tank was constructed to catch the solid material, but it did not receive that care which it should, and the result was that a large part of the finer grain matter was carried with the overflow water, which was still quite warm, into the sewer, where it lodged and in the course of time began to ferment, the gases following up the main sewer and escaping generally through the catch-basins at the corners. This escaping gas was noticed for at least a mile along the line of the main sewer, and occasionally along the lateral branches of the main sewer.. A number of attempts were made to prevent this material from lodging in the sewer, but without much success. A trap door was then placed at the upper connection of the main sewer to a down-fall shaft located a short distance above the distillery overflow connection. Openings were left at the top of this shaft for the gases to escape, the shaft being located in a sparsely populated district. The gases were thus prevented from reaching that part of the sewer which passed through the densely populated districts. The trap door was so constructed as not to interfere with the flow of either storm water or sewage at any time to and through the downfall shaft. At one time it was contemplated placing ventilation connections at the upper end of the various lateral sewers at points alongside the trolley poles of the street railway, which are located conveniently between the tracks in the center of the streets; but nothing was done. That method might have afforded some relief, though perhaps not as much as should be given.

It seems to me that numerous ventilation connections with the main sewers, and possibly with the house drains at the lower side of the main trap, would be a safer solution of the problem than to allow the gases to pass through the drain pipe by doing away with the house trap, and permitting them to escape through the soil pipe to the roof; because by the latter method you are inviting danger through defective plumbing. The people are not all experts in plumbing and do not detect defects in plumbing until after these have made themselves noticeable through escaping gases, and very often not until some member of the family has been taken sick.

THE PRESIDENT: Gentlemen, this doubtless seems to most of us a rather startling proposition, to omit the main house trap, and I have no doubt that Mr. Ball would be glad to have as much discusssion on it as possible.

MR. GEORGE M. AMES, City Engineer, Grand Rapids, Mich.: Mr. President, I think it is about eight or nine years ago since we of Grand Rapids began to ventilate the sewers through the catch-basins, putting in a 6-inch elbow over the trap At that time when the first basin was put in there were some complaints about the ventilation, but we continued the practice until now there are on every sewer, more or less, catch-basins ventilated in that way; and on many of the streets the catch-basins are on each side of the street. I think now for five years there has not been any complaint of the odors from the catch-basins. In going along the streets I occasionally notice a very slight odor as I walk on the sidewalk; but, from the very few complaints, it seems to me that our sewer system has been and is very well ventilated.

Ours is the combined system, and our town is quite hilly. Where the conditions are as we have them it seems to me to be of very small importance, for the ventilation of the sewer, whether that main trap in the house lateral is put in or left out; and yet, if it is of more advantage to the house drain to have the unbroken channel, it would be as well to have the trap left out, because our sewers are, I think, as well ventilated as the house system. And it seems to me that gases would, like everything else, move along the lines of least resistance and go along the soil pipe and be carried beyond the roof.

MR. MCMATH: Since this discussion has progressed a little it appears to me, if I understand the proposition, that the idea is that the sewers need a relief from the contained air when the combined system becomes filled with storm water. I do not know what the practices of other cities are in reference to the location of the house connections in the sewer, but with us in all our brick sewers the house connection is put at the spring line; in all of our pipe sewers it is made at about the center line, so that when the sewers are more than half full, those connections are sealed and are not a means by which the contained airs in the sewer can find vent through the house connections.

I recall certain instances which happened when I was more directly connected with the sewer administration than I am of late, where the houses at the upper ends of the sewers, where the sewers had a pretty steep grade, suffered very seriously; and in fact, life in those houses became almost unsupportable on account of the contained air being driven out through the houses near the top of the system at a time when the lower parts of the system were being rapidly filled with storm water. I recall other cases where at certain times of the year some industrial establishments and some pretty large office buildings had a practice of discharging live steam into the sewers, and the steam manifested itself sometimes by forcing the traps. Now, of course, if there was a free vent to the gas from these sewers through the house sewer, the probabilities are the contained air would have been vented through the soil pipe and the extensions rather than to have forced the traps; but on the other hand, as Mr. Benzenberg suggests, traps are often out of order, or they are dry.

But we have another practical difficulty I used to hear of, and that is that architects and owners are extremely adverse to having soil pipes carried much above the lower part of the house. They object to them being carried above everything on account of what they consider an aesthetic objection. It makes the soil pipe too conspicuous in a good house, so their effort is always to hide it in some little nook, where the sky line is broken by angles; and they generally manage to get it only a few feet above the roof in its lowest part instead of carrying it above the highest part of the house.

I remember we had complaints made of our sewer ordinances being violated in this respect; and when we had an examination made we found that in recently constructed buildings the rule was "violation," and it was found to be practically impossible (and we gave it up) to undertake to enforce the clause of the ordinance which required that the soil pipe should be carried to the highest, or a little above the highest, part of the building to which it was attached. We found it was impracticable, and we had to give it up. The consensus of opinion seemed to be against the enforcement of the ordinance.

GEORGE W. TILLSON, Principal Assistant Engineer, Brooklyn, N. Y.: I was a little surprised that the author of the paper advocated the use of traps on the separate system rather than on the combined, and that he did so principally on visible reasons. When Col. George E. Waring was urging to such an extent the separate system in this country, one of the principal reasons he advocated was the exclusion of the trap and free circulation of the air through the sewer and the soil pipe to the roof. Of course, the separate system can be constructed so as to do its work in a proper manner from day to day, while the combined must be built so as to carry off all the water from all but extraordinary storms, and the great part of the time it is working at a disadvantage, and it seems very probable that a great deal of sewage may be left on the sides of the sewer and there decay and cause more gases than usual in the separate system, where the flow is perhaps uniform from day to day, and anything that is left during the slack hours of the night would be carried off by the increased flow next day.

The theory Colonel Waring worked under was that there could be no forcing of traps without certain pressure, and if you allow free communication from the sewer to the roof, so that when the gases form they can pass off readily to the roof, there would be no pressure and consequently no forcing of the traps, the idea being to keep the sewer so ventilated that the foul air would pass off before any of the dangerous gases were formed, or, as I said before, collect in such a way as to cause a pressure.

As to ventilating the sewers from the man-holes and catch-basins, I think, as has been said by the gentleman from Grand Rapids, that it depends a great deal upon the construction of the system and the conditions surrounding it.

I had about ten years' experience with sewers in Omaha. There we had separate and combined systems, and in the combined system every catch-basin connection was made to the main sewer without a trap and with man-hole ventilation. I have gone through the brick sewers a great many times and found almost no bad odors in them at all; in fact, in talking to a reporter once I was quoted as almost saying that the sewers would make good sanitariums. But the grades there are steep, so that with any appreciable storm the water comes down with such force as to wash everything away, and on account of the extreme elevation between the lower and upper ends of the sewer there is, of course, more draught than there would be in a more flat system. During the whole time that I was connected with the sewers I do not think there was but one basin in the entire system that we ever received any complaints from, and those complaints were in the dry time in the winter, when there was no outside water to flush the sewer.

The engineer of sewers in Chicago some fifteen years ago told me that they were gradually introducing perforated man-hole covers on their system there, and that they were working very well; that sometimes he would have complaints of the odors from the man-hole covers where they were perforated, and that they would replace them with unperforated covers, leaving the latter on for a few weeks and then taking them off and putting on perforated; and that in no case were complaints made a second time when the property owner thought the cover was solid. We all know, of course, that as far as grade is concerned, there is not a city in the country that labors under as many disadvantages as Chicago.

MR. ERNEST ADAM, Engineer in Charge of Pavements of Newark, N. J.: I wish to state, in regard to perforated man-hole covers, that the older part of our sewer system is not provided with such covers. When there was a necessity of inspecting these sewers the gas within them was more discernable than in such that have perforated covers. All sewer basins constructed with a modern trap are ordinarily free from gas. Only during a protracted dry spell, when the water in the basin has evaporated and is not replenished, does any sewer gas escape through the basins. It is more noticeable in the winter than in the summer.

The perforated man-hole covers were recommended for the London sewer system after several other experiments; one of them was the erection of a furnace with a high chimney, in order to ventilate some of the sewers, but it was found that the draft affected the sewers only a short distance from the furnace. Although persons have complained, now and then, about sewer gas escaping through the perforated man-hole covers into the street, yet I could never find any just cause for such complaint.

Mr. McMath said that gas principally accumulates at the upper or higher end of the sewer, where it is forced out during a rainstorm. That is my opinion also. I therefore asked the question at the very commencement of the debate, whether the reader of th article on sewer-traps referred to the separate or combined system of sewers. Staley and Pierson cite a case in their book upon "Separate System of Sewerage," of the construction of a large brick sewer in the city of St. Louis, which was 7′ 3″ in diameter; the flow of sewage during dry weather was gauged with a 12-inch vitrified sewer-pipe for a length of 20 feet. The average depth of flow in the pipe was not over 6 inches, and yet this sewer had to be of such a large size to provide for the surface drainage. When a sewer of a combined system is out of such proportion to the actual flow of sewage and has a flat grade, there is very apt to be a heavy sediment left in the sewer after subsidence of a rain fall; this will cause a sluggish flow of sewage and the formation of little pools, and consequently the development of sewer gas. Therefore it is my opinion that the reader's experiment might be more necessary in a combined than in a separate system of sewers. I believe it is generally admitted that the latter is the ideal method of sewerage, the same as asphalt is for street paving.

THE PRESIDENT: If there are no more questions to be asked or if there is no further discussion, Mr. Ball might like to add to his remarks something which has been suggested by what has been said.

MR. BALL: It is a satisfaction to me to see that this matter is deemed an important one by the gentlemen present. I have observed in the sewers in Washington that there is an accumulation of air, and sometimes a very noticeable one in the case of a rapid entrance of storm water, and it is not easy to make provision for relief from the consequent pressure.

Mr. Benzenberg and Mr. Ames have apparently tried the experiment of using untrapped catch-basins, and Mr. Benzenberg states that in one case there was an odor for a distance of a mile alongside of sewers and there was a constant escape of sewer air which had not been observed until the introduction of an unusual waste with a noticeable smell attracted attention to it. If there be danger from the germs in the main sewers, and if it is dangerous to allow those germs to escape at any point, it would seem that the most dangerous point must be at the surface of the street and at the catch-basins on the corners where people are constantly passing. Is it not better to discharge the germs, as the paper suggests, above the house tops?

MR. BENZENBERG: Mr. Ball says it would be safe to ventilate the sewer and allow the gas to escape at any point, if there is no danger of its containing any disease germs. I think sewer gas should be kept away from habitations; at any rate, from the interior of buildings.

The reason it was possible to detect that particular gas mentioned as having been noticed for nearly a mile was because of the peculiar sour smell that emanates from distillery refuse when in fermentation, and when once encountered can always be recognized.

MR. HARRISON VAN DUYNE, Street and Water Commissioner, Newark, N. J.: Before we leave the sewer question I would like to hear something on a different phase entirely, and that is the disposal of sewage. In Newark our sewers empty in the river with a tide rising and falling 5 feet. The sewers in the immediate center were built some years ago and have become over-loaded on account of the extension to the outskirts. The city authorities planned and were about to give out contracts for the building of a new large sewer that would be built to carry the storm water; but we were met by an injunction from a property owner, and he has carried it through our Supreme Court successfully, preventing us building that sewer on account of its receiving sewage along its line which would be emptied into the ——— River near his dock property. We have no sewage disposal works or anything of that kind, but are depending upon the fact that we were emptying our sewage in tide water, as I have said.

The question I would like to raise and have discussed is whether there has anything new developed during the last year looking to the disposal of sewage without letting it empty into an adjoining stream or lake or whatever it may be, that is practical and satisfactory.

The question in Newark in reference to this particular sewer has been appealed by the city authorities to the Court of Errors and Appeal, which is the highest court in our State; and we are waiting the decision of that court on the subject to know whether we can go on with this sewer. If we are stopped by the highest court, then, although fronting on a tidal stream, we are face to face with the necessity of arranging and building an expensive disposal works.

I would like to hear from some of the authorities here on the question.

THE PRESIDENT: We would like to hear something on the local situation in respect to sewers. It would be of interest to us all, I think.

MR. JONES: I am very sorry that Mr. Rust, our City Engineer, has been called out on important city business, for I think if he were here he could throw a little light on our local condition as to the disposition of our sewage.

I might say that I am in charge of the Street Cleaning Department in the city and come a great deal in contact with the manholes throughout the city; and it has been reported to me frequently that noxious gases and bad smells arise from the sewers. We have a system of flushing the sewers pretty regularly, but no other system of ventilation than by perforated man-holes and open gulleys on the sides of the street.

Mr. Rust told you, before he left the room, that he had attempted to obtain ventilation by means of pipes on the sides of the houses, but that he found a great deal of objection from the property owners. My own opinion from the discussion is that the house trap can hardly be done away with very well for the purpose of getting rid of the gases from the sewers.

Mr. Van Duyne has just asked a question, and I would suggest that we have with us to-day Mr. Barrow, the City Engineer of Hamilton, Ontario—a city where they have gone to some extent into the reduction or disposition of sewage—and I think Mr. Barrow can give the Convention some information as to their system.

MR. BARROW, City Engineer, Hamilton: I might say that some time ago we used to empty the sewage into Burlington Bay, which forms one of the boundaries of the city of Hamilton; but such a nuisance was created that an injunction was served on us, and we were ordered to abate the nuisance in some way or other.

I was not at that time the Engineer. After visiting several of the cities in the United States, and after having made inquiries on the subject, the city authorities came to the conclusion that they would adopt the method of chemical precipitation something similar to that in use at Worcester and Canton; and as we had a very large body of water in which to empty the sewage, they considered that it was not necessary to go to a great extent of purification—that the same amount of purification that a small river would require would not be necessary when the sewage was emptied in so large and deep a body of water as Burlington Bay. Works were built, and they have been in operation now for several years, and we have had no trouble. The people have made no complaints, and the system seems to give satisfaction.

I believe now in Europe that the septic tank method seems to be gaining in popularity, but it appears to have been introduced only in small cities or small towns, and therefore I think it has scarcely had sufficient trial to enable us to pronounce on its merits. Our system has given satisfaction.

The President: Mr. Rust, while you were absent from the room some questions were asked as to the local conditions, the nature of your system, the final disposition of your sewage, and whether or not it has had any injurious effect upon your water supply.

Mr. Rust, Toronto: At present our sewage is all being discharged into the bay and the lake. We have a combined system here and have about 250 miles of sewers. The water supply is taken from about half a mile south of the Island, and about 2 miles from the city. So far we have not been able to find that the sewage has been carried towards the intake. The greatest trouble we have with the sewage is the contamination of the bay, which is largely used in the summer for boating purposes; it is also a nuisance to people living on the north shore of the Island. The question of sewage disposal has been before the Council for several years, and it is up again now. I made a report last year on the matter, and I am now asked for another report. The proposition was made to build intercepting sewers and take the sewage a distance of about five miles east of the city, and then either put it on the land or use tanks and treat it with chemicals and discharge the effluents and residue into the lake.

At the foot of each of our principal streets the sewer empties into the bay, and of course, those sewers constitute a great nuisance to the people who have business in the vicinity on the wharves and to vessels which discharge their passengers or freight at or near these points.

In the western part of the city we have the Garrison Creek sewer, which is one of our largest sewers and which discharges about two and a half millions in twenty-four hours; and our water intake is less than two miles from the mouth of the sewer. There is no doubt that we are getting probably close to the danger point and cannot keep on much longer; but the principal nuisance so far has been from the bay. The bottom of the bay now, for a distance of probably 1,500 feet from the shore, is covered with a deposit of sewage.

A MEMBER: And you have done nothing?

MR. RUST: Nothing except to prepare reports and plans. Messrs. Herring and Gray reported on the disposal of our sewage in 1888. They recommended the discharge of the sewage into the lake at a distance of six miles from our waterworks intake; but since then the shores of the lake have become pleasure resorts, and if their report were now acted upon it would make it very unpleasant for persons at those summer resorts, and would result probably in heavy damage claims against the city.

MR. M. R. SHERRERD, Engineer and Superintendent Water Department, Newark: Somewhat of an experimental disposal works has been installed near your own city, Mr. President—a process by which air is pumped into the bottom of the filters, increasing the bacteriological action, and about one-fifth of the area which is usually used for disposal purposes is used for this process. A gentleman who is connected with it told me they had a plant installed near Brooklyn now in operation.

The President: There has been a plant of this kind in Brooklyn for three or four years. A little place called Homewood was established by the City and Suburban Homes Company in one of the outlying wards of the borough. It was laid out long in advance of any sewers, but they received permission to lay their sewers according to the plan which had been made—full-sized pipes for a combined system. They built the catch-basins and put on the basin heads, but omitted the water-tight bottoms and left out some of the brick in the walls of the basin; and as the soil was gravelly, the storm water which came into the basins was quite readily absorbed. The sewage system was put in by the late Colonel Waring. The space occupied by this system seems very small—it does not look to be many times larger than this room. There is a little settlement there now, I should say of over one hundred or possibly a hundred and fifty houses. The system of purification is that of this forced aeration, and it is said to be remarkably successful. I am told that Colonel Waring was in the habit, every time he visited the plant, of taking a drink of the effluent. The system appears to be quite serviceable, but I cannot give you any details as to the method except that it is operated by forcing air through the sewage.

Mr. Ball: Some who are interested in this subject may not have had their attention called to an important report which has just emanated from the Sewerage Commission of Baltimore, including a report to them by an English engineer of the various processes of treatment of sewage employed in England. It is an exceedingly interesting document to anyone who wishes to keep in touch with such literature.

The President: I know from having a copy of the report that, as Mr. Ball says, it will be valuable to some of you, and copies should be applied for before the supply is exhausted.

Mr. Barrow, Hamilton: I think a report was made by Mr. Manserg, an eminent engineer in England, describing the septic tank treatment. The disadvantage of the chemical purification system is the immense amount of sludge that has to be contended with; by the bacteriological method I think there is no sludge, that it is entirely done away with.

THE PRESIDENT: Is there any further discussion on this question before the subject is closed? If not, we will pass to the report of the Committee on Municipal Data, which is to be presented by Mr. A. D. Thompson, City Engineer of Peoria, Ill.

REPORT OF THE COMMITTEE ON MUNICIPAL DATA.

MR. THOMPSON: The members are doubtless aware that the Committee on Municipal Data last year asked to have the various members of the association examine and criticise standard forms which were then presented. The Committee has been unable to obtain expressions from the members, and therefore this year it presents simply an additional report along the same lines. The report reads as follows:

REPORT OF COMMITTEE ON MUNICIPAL DATA, A. S. M. I.

Meeting at Toronto, October, 1899.

TO THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS:

GENTLEMEN:

Your Committee on Municipal Data presents again the forms of report of municipal operation of water works, street paving and sewer construction departments which were presented last year, and renews its recommendations as follows:

An examination of the annual reports of municipal departments shows great lack of uniformity. Much of this is due to the great differences in methods of keeping accounts, and of beginning and carrying forward public works, on account of differences in State laws, in city charters, and in local conditions. Your Committee is of opinion, however, that the variations in form and matter of reports can be reduced very greatly by agreement to follow, as closely as laws and fixed methods will permit, forms of report proposed by such a body as this and recommended by you and by competent governmental authority as models for the municipalities of the nation.

There are in many reports evidences of lack of co-ordination of departments; of duplication of reports, under circumstances such as to render them even contradictory of each other; of separation of work among several departments which should properly belong to one. and of consequent inability to obtain any adequate idea of the economy of operation of the departments, and to prevent duplications and omissions, which produce waste and serious difficulties. Co-ordination and co-operation of departments will be facilitated by forms such as are proposed, if the city departments are required by law or ordinance to co-operate in giving full information upon the various items of the schedules in their annual reports.

Many reports, especially among the smaller cities, are very meager in their statements regarding the operation of the departments in their technical details, while they are very full of detail as to the exact amount paid on each individual voucher allowed during the year. The forms proposed, so far as they are applicable, will bring order out of this chaos, and enable the authorities to see the extravagance or economy of their methods of construction and operation. Many points of a similar nature might be made.

It is doubtless true that circumstances vary so greatly in different localities that comparisons of operations in different cities are not very satisfactory, and in some cases are misleading; but the fact remains that very valuable conclusions can be drawn from general comparisons of this sort, and much important information gathered from the study of such reports. The schedules presented herewith are intended to cover the larger items, such as can most readily be compared in reports of different municipalities; but they are also intended, as indicated therein, as models upon which to form other more detailed schedules, covering the most minute items of construction and operation if desired. The comparison of reports made on such schedules from year to year is perhaps the most valuable use to be made of the scheme, an intelligent study of the reports enabling the authorities to discover the places where errors of judgment have been made, and to determine where improvements in methods may be made, and the results adopted to methods of procedure. The exact form of these detailed schedules depend so closely on the local circumstances and the personal preferences of the supervisors of the work, that they are left to the judgment of these officers without recommendation.

The general lines of reports are so nearly alike in the nature of the case that it is believed the forms presented, when modified by the collective wisdom of this Society, can be closely followed to great advantage, individually and collectively, by nearly all cities.

The Committee presents forms of water works reports prepared by the Chairman; of sewerage reports prepared by Mr. Beach, and of street reports prepared by Mr. Thompson—each having had special opportunities for study in the line assigned to him.

It is recommended that, when the schedules are amended, enlarged and adopted by the Society, a resolution be adopted, recommending the adoption of the of the schedules by the Census Bureau as the forms for reports requested by that office from the municipalities of the nation, and that a committee be appointed to present this resolution to the proper authorities, to press it upon their attention, and to secure adoption, if possible.

The establishment of a new bureau in any department of the Government is a serious matter, requiring much thought and great labor. To what department the Bureau of Municipal Data proposed by Mr. Herrmann should be assigned is the first question for consideration. It is the opinion of this Committee that a permanent census bureau is a desideratum. The collection of municipal statistics pertains properly to such a bureau. Your Committee therefore recommends the passage of resolutions recommending the establishment of a permanent Census Bureau, with powers and facilities for collection of various kinds of statistics at any and all times as required by Congress, and for the inclusion of a Bureau of Municipal Statistics in the permanent provision for departments in such permanent Census Bureau. Such Census Bureau may or may not be independent of the organization making the usual count of population and industries every ten years. A committee may be appointed to present this resolution to Congress.

The last convention of the American Society Civil Engineers showed some interest in the collection of data regarding the operation of municipalities, and appointed a committee to try to impress upon the authorities in charge of the Census the great desirability of the collection of such data by one or more of the special agents of the Census Department. An offer of co-operation might be passed by this Convention, and the combination of effort of these two Societies, and others that may express an interest, will aid in securing the desired results.

The passage of strong resolutions by the convention of the American Society Civil Engineers and the appointment of the committee are the only expressions of interest in the question which our Committee has had under consideration that we have been able to discover. Lack of time has prevented much personal solicitation of opinions by the individual members of the Committee, and lack of an appropriation for expenses has prevented the sending of a circular letter. An appeal to the members of the Society at the last Convention and in the volume of proceedings has brought no response. A similar appeal to an engineering society by one of the Committee has likewise failed to bring any assistance in criticism or addition. Appeals by the Chairman almost monthly in Municipal Engineering Magazine, which most of you see more or less frequently, brought no responses until last month, and these were not from members of the Society. The Committee has therefore concluded that there is not the absorbing interest in the subject which its importance seemed to insure, and which ex-President

Herrmann assumed would be elicited by a report upon the matter. This does not modify the opinion of the Committee that the subject matter of this report is of very great importance, and that all its recommendations, if put into effect, will be of very material assistance to municipal authorities in bringing order out of the present chaos in most city department reports. The Committee still asks for criticism, and earnestly recommends prompt action upon the report. This is the last opportunity to take action before the forms of Census reports are fixed and the collection of information is begun. Whatever action is deemed proper by the Society must therefore be taken by this meeting.

Respectfully submitted,

CHARLES C. BROWN, Chairman, Bloomington, Ill.
LANSING H. BEACH, Washington, D.C.; by C.C.B.,
A. D. THOMPSON, Peoria, Ill.

MR. THOMPSON: Mr. Whinery, who is Chairman of the Committee on Municipal Data from the American Society of Civil Engineers, might be asked to give a few words on this subject.

MR. WHINERY, Chairman of the Committee on Municipal Data, American Society of Civil Engineers: Mr. President and Gentlemen of the American Society of Municipal Improvements: Most of the information that I can give you has already been given in the report just read. At the last annual convention of the American Society of Civil Engineers a resolution was adopted, asking the Board of Directors of the Society to consider the propriety of impressing upon the Superintendent of the next Census the desirability and importance of collecting data relating to municipal public works, with about the same degree of fullness as other departments of the Census are handled, and authorizing the Board, if found desirable, to open communication with the Superintendent of the Census and offer him the assistance of the Society in formulating the matter and in carrying it out. At the next meeting of the Board of Directors of the Society such a committee was appointed, and this Committee, after considering the subject, thought the first step would be to ascertain from the Superintendent of the Census what he is prepared to do about the matter—to ascertain whether he considered it desirable to have the assistance of the technical societies, such as this Society and the American

Society of Civil Engineers, and to what extent he would be willing to go in making preparations for collecting complete data of municipal public works. A communication has been sent to the Superintendent of the Census, urging very strongly that action be taken, and presenting the importance of the matter in as strong a light as possible. No reply has yet been received from him, and until such a communication is received the Committee will probably take no further action, and the action to be taken thereafter will depend very largely on the attitude of the Superintendent of the Census in regard to the matter. It was suggested in this communication that undoubtedly other scientific, technical and economic societies would be very glad to co-operate with him in collecting data and preparing reports, and everything of that kind that would help to make such a census more complete and more successful.

The President: In connection with this subject I wish to state that I have had some correspondence with Mr. Merriam, the Superintendent of the Federal Census. I wrote to him last August, calling his attention to the fact that the advisability of including in the next Census statistical information concerning the cities of the United States and their public works had been agitated for some time by technical journals and in the daily press. I advised him of the fact that the Committee on Municipal Data of this Society had been preparing forms for reports on various public works, and that the question of collecting municipal statistics would undoubtedly be brought up at this Convention.

I furthermore stated that I felt confident that I could assure him of the hearty co-operation of this Society, and thought it could render valuable assistance in the collection of this data. Mr. Merriam promptly replied, stating it had been decided that the four principal sub-divisions of the work, viz., Population, Vital Statistics, Manufactures and Agriculture, would be taken up and completed before any other subjects were undertaken, and when the time arrived to consider these other subjects he would be very glad to consider our suggestion, and did not doubt that the Society could be of substantial assistance to him.

Now, I think it important that this report of the Committee and the forms recommended should have full and free discussion, and now is the proper time to have it. You have all had the forms before you for nearly a year, and you know what they are, and possibly some of you have attempted to use them. If so, we would like very much to hear how they impressed you; whether or not they seemed too complex. Any suggestion you may make towards improving them will doubtless be gladly received by the Committee.

Mr. Thompson: As a member of the Committee, I desire to state in reply to the President's criticisms that the information requested in the Committee's recommendations does not enter into details to a greater degree than the Census Bureau requires regarding the subjects upon which it collects statistics. It is certainly necessary, in determining the cost of pumping, to know what the price of coal is per ton, the character of same, the amount paid for labor, the amount of water pumped, etc. Without these details the data would be practically worthless. We might say a pavement costs so much per square yard, but if the various items included therein are not mentioned the lump sum is of no value.

Mr. Tillson: I do not think that this Society could place too much importance on this subject. It seems almost impossible now to get any information from outside cities as to the data concerning municipal improvements. I think one of the important things that this Society could take up and solve is the problem how to collect them. I have been trying during the last year to get information of the public improvements in this country and in Europe, and I find that almost invariably my communications to European people have been replied to much more promptly and completely than those of this country. I do not know whether it is that the records of this country are kept in such a way as to make it impossible for our officials to give answers, or whether it is on account of their native caution; but I do not think that this Society, or any Society, or the Census Bureau, can accomplish this in one year. I think it is something that must be carried on continually. I think the idea of appointing a permanent bureau of this Society to take up the matter is the best way to accomplish that. These forms of reports of the Committee, I think, are none too elaborate for what is required, but I do think they are too elaborate to start with. If you send that schedule to the average official in any city, if the official does not see fit to reply the Census Bureau has no more information than if I asked for it. He will throw it aside because it involves too much work, or because it involves a great many subjects that he does not know anything about; and he does not want to show his ignorance on the subject.

Now, my idea, as I intimated before, is that we should have a bureau in this Society working with the Census Bureau too, and have this Bureau continuous, with all its records turned over from year to year; and that the members of this Bureau next year, if they happen to be the same as this year, fill up the details that the Committee this year was not able to obtain, and so on, and in a few years we might get some information that would be very valuable. But I do not believe that the Census Bureau or any committee in the Society can do it in one year.

As an illustration of the results that will be obtained in trying to get information of the public improvements, I want to read you a little information that I gathered on the subject from the "Municipal Engineering," the magazine that is on the table here. In September they published two tables giving information as to pavements in this country, one of them compiled by the magazine and another by a correspondent. In those two tables statistics of brick pavement were given of six cities, as follows:

	One Report.	The Other Report
Bloomington, Ill.	18.75 miles	20 miles
Davenport, Ia.	348,641 sq. yards	467,684 sq. yards
Evanston, Ill.	94,806 sq. yards	42,907 sq. yards
Peoria, Ill.	473,194 sq. yards	473,194 sq. yards
(That was correct; but there was a difference of .00 in mileage.)		
Rockford, Ill.	1.85 miles	2.70 miles
St. Joseph, Mo.	120,000 sq. yards	107,433 sq. yards

Out of the six cities that were given in both tables, only one of the cities was given correctly in both, and some of the reports varied in the same city as much as 50 per cent. Both reports were published in the same issue, and I do not doubt that each one of those compilers worked with the same amount of care and with as great a desire to get correct results, but the difference came from the inability of the city officials to furnish the same information to-day as that furnished within six weeks or six months, on account of the way their records are kept.

MR. SHERRERD: I was called upon by some Census representative about nine months ago in regard to water-works data. The agent came around himself and spent an afternoon with me going over the different items on the sheet. We worked on it faithfully and straightened out certain matters that he wanted entered in a different way from that in which our accounts were kept. He said he would come back again, but I have not seen him since. I imagine the Census Bureau did undertake to get statistics in regard to water works, and I think they meant to make it general; but I imagine, from the failure of the agent to return, that they have given up the collection of this information.

THE PRESIDENT: I know that such a paper was presented to the Department of Water Supply in Brooklyn, and that they filled out all the information asked for, and it simply seemed to whet the appetite of those seeking information, because they sent back and asked for more. But that was not the Federal Census.

MR. M. N. BAKER, of the "Engineering News," New York: It was from the U. S. Commissioner of Labor, Mr. Carroll D. Wright.

MR. TILLSON: Mr. Sherrerd spoke of an agent coming to him and going over the subject. That is the same idea I advanced to the President about a month ago, that the only way to complete this data at the present time would be to send a man around to each city and harmonize the differences of bookkeeping which he found; and that would take him more than one year.

MR. SHERRERD: I think Mr. Tillson is right in that. I find it is very difficult to get tabulations for comparison the same in different places. There are different ways of tabulating figures, which seem to make it impossible to arrive at intelligent comparisons.

MR. MCMATH: The statement was made by the agent who came to St. Louis that the only way to get this information was to go after it and to go through the various departments and collect it for yourself. But when he came to St. Louis it was financial questions only that were asked; he wanted to know how much had been spent for water works, and how much had been spent for sewers. It was financial information he was obtaining.

THE PRESIDENT: It would be interesting to know to what extent the forms recommended by the Committee on Municipal Data had been used by city officers in the Society; they certainly have been studied by them. Is there any noticeable influence of this report in the latest Annual Reports which have been made? Have these forms been adopted?

Do you know, Mr. Thompson, whether those forms or modifications of them have been used?

MR. THOMPSON: The Society has apparently paid but very little attention to the forms. It is hardly practicable to use these forms at present in the reports of the various officials. The main object, it would appear to me, of these forms at present is to place the data obtained from the different cities upon the same basis, for the purpose of comparison.

THE PRESIDENT: The principal object of appointing the Committee was to try and have some uniformity in our municipal reports, and to try to induce city engineers or other officers to give the same information and to give it the same way.

MR. THOMPSON: That was one of the primary objects. But so far as the Committee has been able to learn, these forms have not been followed by any of the members.

MR. ADAM: If there is no assurance that the Census Bureau will take up the subject of municipal improvements, is there any object in undertaking such a laborious task as the collection of statistics pertaining to all departments of municipal offices.

THE PRESIDENT: I think you misunderstand the object of this Committee. I do not think the Committee recommended that a special committee be appointed to secure this data; it was to get the Federal authorities, the Superintendent of the Census, to adopt some kind of form and schedule of information which he would use and collect through his own agents. I do not think the Committee had any idea of volunteering to convert itself into a Federal Census Bureau.

MR. SHERRERD: When I received the proposed form for water works last year I looked it over carefully in the hope that I would be able to follow some leading of this kind; but I found, and I think most water works engineers or superintendents will find, a difficulty in having their own system of accounting correspond to this sort of detailed statement. From our reports it would be quite easy to give the answers to these several statements; but our accounts are not kept in the same form, and it would take considerable work to get them exactly in this form. To attempt to change to this form would require some years and would necessitate such radical changes in the water works department accounts as to render it impossible to get different cities to keep them in uniform shape. Since the laws governing the several municipalities are different, and the manner in which the departments are looked after change with the different officers in charge, the form of keeping the reports necessarily varies in the different cities. To attempt to formulate any scheme of this kind that could be generally adopted throughout the cities represented by this Society I think would be almost an impossibility.

MR. HERRMANN: It seems to me the most important thing to do in this matter at this time is to impress the Federal authorities with the necessity of taking hold of it. The forms submitted by the Committee may be good, bad or indifferent, but as long as the Federal authorities do not take hold of it we are not going to get the data. I think the suggestion that is offered by the Committee, that steps be taken looking towards the appointment of a committee that would co-operate with the Committee, of which I understand Mr. Whinery is Chairman, is a good one, and the necessity of taking hold of it at once would be a step in the right direction. The matter of forms would come afterwards, and they could be improved upon year after year if the thing is once begun.

THE PRESIDENT: Mr. Herrmann's remarks are certainly to the point, and I think this is the proper time to entertain a motion. The Committee did not offer a resolution.

MR. THOMPSON: Merely a suggestion.

THE PRESIDENT: The Chairman would be glad to entertain a resolution authorizing the appointment of a special committee or delegating this to the Committee.

Moved and seconded that a special committee of five be appointed to take up the matter of municipal statistics with the Census authorities to endeavor to impress upon them the importance of the subject and to induce them to make it part of the Census; to make a permanent Municipal Data Bureau, as part of the Census Bureau; and that the Committee be also instructed to co-operate with a similar committee of the American Society of Civil Engineers and any other committees of technical societies that may be appointed.

The President put the motion, and, on a vote having been taken, declared it carried.

THE PRESIDENT: The Chair will announce the committee later. Is there any further discussion on this subject.

MR. WHINERY: Mr. President and Gentlemen of the Society, I have listened with much interest to the discussion on this subject. It is one I have given a good deal of attention to, and if it would not be imposing on you I would like to make a few further remarks on the subject.

THE PRESIDENT: We will be delighted to hear Mr. Whinery.

MR. WHINERY: It is a very large subject, so large that no society like this, or the American Society of Civil Engineers, or any other society formed on the same basis, could hope to do anything with it. Not only will it require a vast amount of work on the part of somebody, but a large expenditure, which no society, as at present organized at least, can meet. It is said the Government may object to collecting and publishing this information because of the cost and because of the technical character of the information that is necessary and the multitude of the details which will constitute a necessary part of such work. Now, I do not believe the Government will object to this if it is presented in proper shape. You, Mr. President, have to-day told us what a very large amount of money is involved in municipal public work in this country; you have told us what a very large proportion of the population of this country lives in the cities; and from some little investigation of my own I think it is safe to say that this matter of municipal public works is directly interesting to one-fourth of the population of the United States to-day. It is certainly information that possesses very great value to municipal authorities and civil engineers. It is information which city authorities wish in considering plans for improvements in their cities, and it is information which civil engineers want and need when they are called upon to consider and report upon questions for municipal authorities. It is information that we have a right, as municipal authorities and as engineers, to call upon the Government for. It is not a question of favor. If it is worth while to collect information as to the number of sheep and number of calves, and particularly the detailed information which may not go quite as far as my friend Mr Thompson spoke of, it is certainly allowable to collect statistics of important municipal works, and I see no reason why we should not expect and should not insist on having this information, which is really vastly more important, collected and presented in the same way.

It is very true it will require quite a different order of talent to collect this information and to put it in shape for publication; but it is a kind of talent that can be secured. It will require that an expert in each department, perhaps, be put at the head of each particular division—for instance, the collection of statistics of water works will require an expert in that line, who should have authority to make his plans and to send out expert assistants to work with the city engineers and municipal authorities, to harmonize these conflicting accounts that have been spoken of and to get this information in such shape that it would be available for use.

I think the Government will not strongly object for the reason that, as doubtless most of you know, quite an effort was made in the last Census to do this, and really the volume of information published is something surprising when we consider that no special effort was made to make the informaton complete. The work has thus already been begun by the Government; and what we need to do now is to insist that it should be carried out most thoroughly, under proper organization, to get the information and to present it in a way that will be useful to those for whom it is intended.

THE PRESIDENT: Is there anything further to be said on this subject?

MR. GNIFFKE, City Treasurer, Dubuque, Ia.: From the remarks these gentlemen have made here I see that the Bureau of Labor and Statistics has done quite an extensive work. I know they were at work because they were a day and a half in my office. Possibly we could obtain more through the Bureau of Labor than the Census Bureau.

MR. M. N. BAKER, of the "Engineering News," New York: I request the privilege of the floor for the purpose of making a few statements which it seems to me would fill some gaps in the discussion. I would state for the information of the Society that a recent session of Congress authorized the Commissioner of Labor to compile and publish statistics of cities of the United States having over 30,000 population. (See "Statistics of Cities," Bulletin No. 24, U. S. Department of Labor, September, 1899.) The previous investigation started by the Commisssioner of Labor was originated in 1895-6 by the National Association of Bureaus of Labor Statistics, an organization composed of officers of the various State Labor Bureaus of the United States. In 1896 the Association sent invitations to different authorities on statistics, asking them to send suggestions to be presented to a meeting of the Association which was to be held at Albany in June, 1896. The object of that particular investigation was to enquire into the relative advantages of private and public ownership of water works, lighting plants and street railways. Many suggestions were submitted, and it was resolved that the investigation should be taken up by the different State Labor Bureaus where they were in a position to do it; and where they were not, it was understood that Mr. Carroll D. Wright, the United States Commissioner of Labor, through the funds of his department, should carry on the investigation. The investigation has been carried on by some of the State Bureaus, and some of the results have been published.

Away back in 1886 a committee of the American Water-Works Association worked up a form for reporting water-works statistics (see fifth annual report of the association), but so far as I know it has not been adopted to any very great extent.

About the same time, or a little earlier, the New England Water-Works Association formulated a plan for statistics of water-works which has been carried out by the water-works officials throughout the country to a very considerable extent. Members of the New England Water-Works Association especially—membership not being limited to New England—have adopted that form ,and there is now available much valuable information on a uniform basis, both in the reports of the numerous water departments that have adopted the plan and in yearly summaries published in the Journal of the New England Water-Works Association.

There are, then, three or four lines of investigation similar to what is under discussion here which have either been proposed or actually undertaken.

The general scheme, of course, is one which is very praiseworthy, but as for inducing all the different municipal officials through the country to adopt and carry out faithfully any particular scheme, it seems to me it is a very serious question and a very difficult problem. The greatest hope, it would seem to me, and in fact the only practicable way to put the matter of municipal statistics on a uniform basis throughout the country, is by working through the State Legislatures—I am not referring now so much to the advisability of the proposed enquiry on the part of the next Census. In one or two States it has been proposed to establish a bureau to have charge of a system of uniform accounting for cities in order that figures might be available which are reliable and readily comparable. An attempt of the sort was made in the New York Legislature within a year or two, and it failed before the law was enacted. I think the National Municipal League is at work on something of that sort, and I believe that in its report on a model city charter, which was presented last year at the Indianapolis meeting of the National Municipal League, there was a provision for a uniform system of accounting. It is certain that nothing short of a permanent Census Bureau will result in much that is of value in connection with the Census statistics.

When you look at the reports of the last Census you will see that there were a few so-called vapor lamps in New York city, and that they put the whole population of New York city into the total cost of running those vapor lamps a year and set down in cold figures the cost per capita for vapor lamps a small fraction of a cent per capita. That is the way some of the municipal statistics were handled in the last Census. Of course this is an extreme case. When you look over all the statistics the Census Bureau has ever published you will see they amount to comparatively little, nor is it easy to find specific information elsewhere. It seems to me, however, that more is likely to be accomplished for the next Census, and until we have a permanent Census Bureau, with a more moderate scheme, including the collection of a limited range of information regarding each class of municipal public works, we may at least know whether a given city has got a gas plant, for instance, or a sewerage system, by a compact table to be compiled presenting this information for each city and village. Two or three columns devoted to gas works, for instance, might indicate by yes or no, or in some other simple manner, whether or not the city had gas works; and by an asterisk, whether the works were owned by the city or by a private owner; also the number of miles of mains as showing the extent of the works. Such a scheme followed for each class of municipal works would be perfectly feasible and would give us a great deal more information than we have got now or ever have had. In addition to this, some of the more important cities might be selected and pretty full schedules devised for those.

Henry J. Wiley, Secretary Street and Sewer Department, Wilmington, Del.: In connection and with reference to Government officers making enquiry, I would say that one of those officers of the Labor Bureau called and spent a full day with me—two half days on two different days. He stated that he had been through the West in the summer time collecting information for the government of the water-works and electric light plant and instruction was then given him to go to the cities of 30,000 and over in connection with twenty-five or thirty of their officers, to collect information embracing the number of miles of streets in cities, the amount of improved pavements, the class, the mileage and the average cost. He included all these things. We gave him that information, and he showed me reports of the different cities where he had been in the early spring. He said the Government had sent out specially some twenty-five men, as an experiment, to satisfy an enquiry that had been made at their Bureau. I have not heard from the gentleman since that time.

The President: Is there any further discussion on this question? If not, this completes the program for this afternoon. But before we adjourn I would like to state, for the benefit of some of the members who were not here this morning, and who consequently did not hear the announcement, that the complimentary trolley ride to be given by the Toronto Railway Company is scheduled for 10 o'clock to-morrow morning. The cars will leave the side-track on Front Street in front of the Union Station at that hour. I hope the starting of the cars will not be delayed as long as the starting of the meeting was this afternoon.

I also wish to say that the selection of committees on the nominations of officers and on the next place of meeting has been made a special order of business for the opening of the evening session, which is scheduled for 8 o'clock. Permit me to say that not later than 8:15 I shall call the meeting to order; and if there is no one in the room but myself, I will proceed to select the committees.

Mr. Sherrerd: In adding to the names of the delegates from Newark, I wish to present Mr. J. B. Stobaeus as a member of the Society.

The President: One of the orders of business this morning was the election of new members. We will, with the consent of the Society, revert to that order of business now.

On motion, the meeting reverted to order of business No. 3.

On motion, the Secretary cast a ballot (on behalf of the Society), in favor of the applicant.

The President: I declare Mr. J. B. Stobaeus, member of the Board of Trade of Newark, New Jersey, duly elected a member of this Society.

On motion, the Convention adjourned to meet at 8 o'clock p. m.

EVENING SESSION.

Tuesday, October 3, 1899, 8 o'clock p. m.

The President, in the chair, called the meeting to order.

The President: At this morning's session the selection of the Committee on the nomination of officers and the Committee on the next place of meeting was made the first order of business for this session. I will now call for nominations for the Committee on the nomination of officers:

SELECTION OF THE COMMITTEE ON THE NOMINATION OF OFFICERS.

The following gentlemen were nominated for the Committee on the nomination of officers:

Mr. George H. Benzenberg, Milwaukee, Wis.
Mr. Harrison Van Duyne, Newark, N. J.
Mr. George M. Ames, Grand Rapids, Mich.
Mr. Joseph Elder, Peoria, Ill.
Mr. Bernard Saunders, Toronto, Ont.

On motion, the nominations were closed.

MR. A. D. THOMPSON, Peoria, Ill., moved, seconded by Mr. Adam, Newark, N. J., that the Secretary be instructed to cast a ballot on behalf of the Society for the appointment of Messrs. Benzenberg, Van Duyne, Ames, Elder and Saunders as a committee on the nomination of officers. Carried.

On instructions of the President, the Secretary cast a ballot on behalf of the Society.

THE PRESIDENT: The Secretary reports that a ballot has been cast for the appointment of the Committee on the nomination of officers for the ensuing year in favor of Messrs. Benzenberg, Van Duyne, Ames, Elder and Saunders, and I declare the Committee, as nominated, duly selected.

This Committee will be expected to report at the session to-morrow (Wednesday) evening, when the election of officers will take place.

SELECTION OF THE COMMITTEE ON THE NEXT PLACE OF MEETING.

The following gentlemen were nominated for the Committee on the next place of meeting:

Mr. August Herrmann, Cincinnati, O.
Mr. George W. Ballard, Newark, N. J.
Dr. W. C Woodward, Washington, D. C.
Mr. A. D. Thompson Peoria, Ill.
Mr. Edwin A. Fisher, Rochester, N. Y.

On motion, the nominations were closed.

On motion, the Secretary was instructed by the President to cast a ballot on behalf of the Society in favor of the gentlemen named as members of the Committee on the next place of meeting.

On instructions of the President, the Secretary cast a ballot on behalf of the Society.

THE PRESIDENT: The Secretary reports that a ballot has been cast for the appointment of the Committee on the next place of meeting in favor of Messrs. Herrmann, Ballard, Woodward, Thompson and Fisher, and I declare the Committee, as named, duly selected.

THE PRESIDENT: The first paper on our program is the report of the Committee on Taxation and Assessment, by Mr. August Herrmann, Commissioner of Water-Works, Cincinnati, O., Chairman of the Committee.

REPORT OF THE COMMITTEE ON TAXATION AND ASSESSMENT.

MR. AUGUST HERRMANN, Commissioner of Water-Works, Cincinnati, O., Chairman of the Committee: The Committee has no report to present as a committee. Mr. Geo. P. Bouton, of Jersey City, N. J., as a member of the Committee, has prepared a paper, but I understand he has communicated to the Society that he will not be here until some time to-morrow, and asked that the matter be held open until his arrival.

As a member of the Committee I have also prepared a paper entitled "Water Rates and Statistics pertaining thereto in the larger Cities of the United States," which I will read to you as follows:

WATER RATES AND STATISTICS PERTAINING THERETO IN THE LARGER CITIES OF THE UNITED STATES.

BY AUGUST HERRMANN,

COMMISSIONER OF WATER WORKS, CINCINNATI, OHIO.

TO THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS, AT ITS SIXTH ANNUAL CONVENTION:

GENTLEMEN:

A year ago, as Chairman of your Committee on "Taxation and Assessment," I submitted a paper on the "Rates and Taxation in the Larger Cities of the United States." This paper, it was believed, covered all of the principal features which had a direct bearing on the question of taxation in the cities to which it had reference. This year, I did not deem it advisable to again submit a paper on this same subject, believing that it would be better that a few years should elapse before general statistics should again be gathered. In the paper submitted to the Society a year ago, it developed that mistakes in securing the data had occurred in the cities of Pittsburg, Pa., Allegheny, Pa., and Rochester, N. Y. Attention was called thereto by the members of the Society from those cities, and a sheet inserted in the Annual Report making the necessary corrections. In the concluding paragraphs of the paper referred to, it was stated that it was almost impossible to secure reliable and accurate data, because of the many different systems in vogue in the leading cities of the country. It was recommended that this Association should take the initial steps towards inaugurating and securing a uniform system of assessing property, levying taxes, classifying receipts, distributing revenue, etc. Considerable headway has been made in this direction in several States during the past year, and particularly so in Ohio, where a codifying commission was appointed under an Act of the General Assembly to formulate a plan providing for a uniform system of government for that State. This Commission will report during the coming winter, and it will afford me great pleasure to submit a synopsis of their report for your consideration at our next annual meeting.

The paper submitted this year, viz: "Water Rates and Statistics pertaining thereto in the larger Cities of the United States," may properly be classified as coming under the head of "Taxation and Assessment." The question of the amount charged for water is an important one in every city. It is very often the case that officials having the management of water departments are unnecessarily and unintelligently criticised for the reason that the water rates of their respective cities are so much higher than those of other cities to which a comparison has been made. As a rule these criticisms are made by those who have not closely examined into the conditions bearing on this subject in the various cities, simply taking as an argument the prices charged per 100 cubic feet of water in one city, as compared with that of another city, or some like basis of calculation, and then charging mismanagement on the part of the department having the high rate. Such a claim is ridiculous. In making comparisons, all of the conditions of the department must be taken into consideration; the source of supply, the manner of pumping and repumping the water; the discount on the water bills; the charges against the water fund, and such other matters as would necessarily affect the cost of operation and maintenance.

In gathering the data for this paper it was deemed advisable to secure not only the water rates as charged in the different cities, but general statistics that might have a bearing on this subject. As was done last year, the information to be obtained was confined to cities that had a population of 80,000 or more, at the last United States census, excepting therefrom the City of Washington, D. C., alone, believing that the conditions existing there were so different from those in other cities that an intelligent comparison could not be made. Of the thirty-one cities in the country coming under that heading, data has been obtained from all of them, excepting the cities of Worcester, Mass., Denver, Colo., and San Francisco Cal.

In some of the cities water rates are enumerated under no less than several hundred items. It would be almost impossible to prepare a table showing these different enumerations and comparisons. However, all of the data obtained will be preserved, and should any of the members of the Society desire information in any particular item of charge, the same will be furnished on application.

I will present, first, several tables showing the rates charged for water, taking as a basis the principal items of revenue of water departments. The first table shows the rate charged for water furnished through meters which, in most instances, is the largest single item of revenue in water departments. In some of the cities water is furnished through meters, giving a price per 100 or 1,000 gallons; in others per 100 or 1,000 cubic feet. The table shows the rate computed on basis of charge per 100 cubic feet and is as follows:

RATES CHARGED FOR WATER FURNISHED THROUGH METERS.

PRICES COMPUTED ON BASIS OF CHARGE PER 100 CUBIC FEET.

NAME OF CITY.	RATE PER 100 CUBIC FEET.	REMARKS.	MINIMUM RATE.
Detroit, Mich......	1.17 to 3.74 cents	Graduated According to Consumption	50c per month.
Buffalo, N. Y......	1.50 to 4.46 "	" " "	$24 per Annum.
Toledo, O........	2.62 to 7.48 "	" " "	$6 to $10 per Annum.
Chicago, Ill.......	2.94 to 7.48 "	" " "	
Kansas City, Mo...	2.99 to 23.19 "	" " "	
Philadelphia, Pa...	3.00 "		
Syracuse, N. Y....	3.50 to 14.00 "	" " "	
Cleveland, O......	4.00 "		
Albany, N. Y......	4.49 "		
Louisville, Ky....	4.49 to 11.22 "	" " "	700 gallons daily or less 10c.
Baltimore, Md	4.50 "		
Milwaukee, Wis. ..	4.50 "		$1 per Annum for reading Met.
Columbus, O......	4.50 "		
St. Paul, Minn....	5.00 to 10.00 "	" " "	Also a reduction of 1 Mill for each 1000 feet in excess of 50,000 feet per month, down to a minimum charge of 3.37c per 100 cubic feet.
Indianapolis, Ind..	5.24 to 14.96 "	" " "	
Minneapolis, Minn.	5.98 "		
Pittsburgh, Pa .. .	5.98 to 14.96 "	" " "	
Nashville, Tenn....	6.00 to 15.00 "	" " "	
Cincinnati, O......	6.50 to 8.00 "	" " "	
Newark, N. J......	6.53 to 11.50 "	" " "	
Allegheny, Pa	7.48 "		
Rochester, N. Y ...	7.48 to 10.47 "	" " "	$5 per Annum.
St. Louis, Mo.	7.48 to 22.44 "	" " "	
Omaha, Neb.......	7.48 to 26.18 "	" " "	
Brooklyn, N. Y ...	7.50 "		
Jersey City, N. J...	7.50 to 13.50 "	" " "	
Boston, Mass......	8.00 to 14.00 "	" " "	$15 per Annum.
New York, N. Y. ..	10.00 "		
Providence, R. I...	11.22 to 14.96 "	" " "	A special rate is made where the consumption is over 10,000 gallons daily.
New Orleans, La...	11.22 to 26.18 "	" " "	

From this table it will be seen that of the thirty cities enumerated twenty have a graduated meter rate, according to the amount of water consumed, while ten have a straight rate. The lowest graduated rate is in Detroit, being 1.17 to 3.74 cents; Buffalo coming next—1.50 to 4.49 cents per 100 cubic feet—while New Orleans has the highest rate, being 11.22 to 26.18 cents. The lowest straight rate is 3 cents at Philadelphia, Pa., and the highest straight rate is in New York, boroughs of Manhattan and Bronx.

Another big item of revenue of water departments is that received from dwelling houses. As has already been stated, it is almost impossible to take up all of the items for comparison. The next table shows the rates charged for a six-room dwelling house occupied by one family, containing attic and basement, lot, say, from 18 to 20 feet front, two stories high, having the following privileges: One yard hydrant, one kitchen sink, one stationery washstand, one bath—hot and cold water—one self-closing closet, one two-tray laundry and sprinkling 50 square yards of lawn.

This table is as follows:

SIX ROOM DWELLING HOUSE.

OCCUPIED BY ONE FAMILY; CONTAINING ATTIC AND BASEMENT; LOT, SAY FROM 18 FT. TO 22 FT. FRONT; TWO STORIES HIGH HAVING THE FOLLOWING FIXTURES:

CHARGE PER ANNUM.

When blank spaces appear there are no extra charges for those fixtures, the same being included in the first charge for house.

NAME OF CITY	6 room house as described	1 yard hydrant	1 kitchen sink	1 stationary wash stand	1 bath, hot & cold water	1 self-closing water closet	1 two-tray laundry tub	Sprinkling lawn 50 sq. yds.	TOTAL
Detroit, Mich.	2.00			0.50	1.00	1.60		0.60	5.70
New York Manhattan Bronx. 1	7.00							Prohibted	7.00
Cleveland, O.	4.00				2.00	2.00			8.50
Chicago, Ill. 2	7.00							2.00	9.00
St. Paul, Minn	3.80				2.00	2.00		1.50	9.30
Buffalo, N Y. 3	3.50				1.00	1.50		2.25	9.75
Minneapolis, Minn.	1.80			0.50	2.00	2.50		3.00	9.80
Brooklyn, N. Y. 4	8.00							2.50	10.50
Baltimore, Md. 5	12.00								12.00
Cincinnati, O.	5.20			0.90	2.70	1.50	1.00	1.00	12.30
Rochester, N. Y 6	According to value of building, estimated value of building at $3,000 assessed at $5.00				2.00	2.00		4.00	13.00
Louisville, Ky	6.00			0.50	2.50	3.00	1.00	1.00	14.00
Indianapolis, Ind.	5.00				3,00	3.00		4.00	15.00
Toledo, O.	5.00			1.00	3.00	3.00	2.00	1.00	15.00
Columbus, O.	3.98				2.66	2.00	3.33	3.33	15.30
Milwaukee, Wis. 7	6.00			1.00	3.00	2.00	2.00	2.50	16.50
Newark, N. J. 8	6.25				5.00	2.50		3 00	16.75
Kansas, City, Mo.	5.50				4.25	4.00		3.20	16.95
Pittsburg, Pa.	7.00		1.00		1.00	3.00		5.00	17.00
Albany, N. Y. 9	12.00							5.00	17.00
Jersey, City, N. J. 10	10.45				4.00	3.00		Only permitted on Metered premise	17.45
Boston, Mass. 11	According to value of building, estimated value of building at $3,000 assessed at $8.00					5.00		5.00	18.00
St. Louis, Mo.	6.00				5.00	5.00		2.50	18.50
Philadelphia, Pa.	5.00				3.00	1.00	5.00	5.00	19.00
Allegheny, Pa. 12	10.25			1.50	3.00	2 00		2.50	19.25
Syracuse, N. Y.	5.00				4.00	5.00		6.00	20.00
Omaha, Neb.	6.75			1.00	3.50	2.50	2 00	5.00	20.75
Nashville, Tenn. 13	6.00				8.00	6.00		1.50	21.50
Providence, R. I.	6.00			2.00	5.00	5.00	3.00	5.00	26.00
New Orleans, La.	11.00		4.00	2.50	3.75	6.00	4.50	Only by Meter or contract	31.75

Notes.

1. New York, Manhattan. Approximated on frontage rates, 2 story building 20 ft. front.
2. Chicago, Ill. " " " " "
3. Buffalo, N. Y. " " " " "
4. Brooklyn, N. Y. " " " " "
5. Baltimore, Md. " " " " "
9. Albany, N. Y. " " " " "
10. Jersey, City, N. J. " " " " "
7. Milwaukee, Wis. The rates charged in Milwaukee under surveys entitle the consumer to a fixed amount of water only.
8. Newark, N. J. In addition to dwelling house charge and special charge as shown there is also a charge of $1.25 for kitchen boiler.
11. Boston, Mass. Dwelling houses assessed according to valuation. A house valued at $1,000 is assessed at $6.00 per annum, this rate is increased for each $1 000 or part thereof $1.00 per year.
6. Rochester, N. Y. Dwelling houses assessed according to valuation. A house whose assessed valuation is $1,500 or less is assessed at $4.00, it is then graduated up to $7.50 according to valuation.
12. Allegheny, Pa. Closet and sprinkling rates are figured at minimum prices.
13. Nashville, Tenn. This rate is for three persons or less, each additional person $2.00.

From this table it will be seen that for this kind of a dwelling house Detroit has the lowest rate, viz, $3.70 per annum; New York (Boroughs of Manhattan and Bronx coming next) at $7.00 per annum The highest rate is at New Orleans—$31.75 per annum. The average rate is $15.42, fifteen cities being below and 15 cities above the average.

The next table shows the rates for a larger dwelling house, viz, a twelve-room house, occupied by one family, containing attic and basement, lot, say, from 50 to 60 feet front, three stories high, having the following privileges: One yard hydrant, one kitchen sink, three stationery washstands, two baths—hot and cold water—three self-closing closets, and sprinkling 150 square yards of lawn.

This table is as follows:

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Baltimore, Md.	1	[illegible]		.	.			....	...	[illegible]
Detroit, Mich.		[illegible]	..	..	1.[illegible]	[illegible]	[illegible]		1.[illegible]	[illegible]
Cleveland, O.		[illegible]	.	....		[illegible]	1.[illegible]	...	.	[illegible]
Rochester, N. Y.		[illegible]	..	..		[illegible]	4.[illegible]	...	4.[illegible]	[illegible]
St. Paul, Minn.		[illegible]	.	.		[illegible]	1.[illegible]		[illegible]	[illegible]
Buffalo, N. Y.	3	[illegible]	..	...		[illegible]	[illegible]	.	4.[illegible]	[illegible]
Minneapolis, Minn.		[illegible]	...		[illegible]	4.[illegible]	[illegible]	.	[illegible]	[illegible]
Syracuse, N. Y.		[illegible]		....	.	4.[illegible]	[illegible]		1.[illegible]	[illegible]
New York City	4	[illegible]	..			[illegible]	4.[illegible]		Prohibited	[illegible]
Cincinnati, O.		[illegible]		..		[illegible]	4.[illegible]	[illegible]	4.[illegible]	[illegible]
Newark, N. J.	5	[illegible]	.			[illegible]	[illegible]		[illegible]	[illegible]
Toledo, O.		[illegible]	.	..	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Cincinnati, O.		[illegible]	.	..	[illegible]	[illegible]	4.[illegible]	[illegible]	[illegible]	[illegible]
Philadelphia, Pa.		[illegible]	.		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Louisville, Ky.		[illegible]			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Brooklyn, N. Y.	7	[illegible]				[illegible]	4.[illegible]		[illegible]	[illegible]
Indianapolis, Ind.		[illegible]				[illegible]	[illegible]	–	[illegible]	[illegible]
Chicago, Ill.	6	[illegible]			[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
Pittsburg, Pa.		[illegible]		1.[illegible]	[illegible]	[illegible]	[illegible]	. .	[illegible]	[illegible]
Boston, Mass.		[illegible]	.				15.[illegible]		5.[illegible]	[illegible]
Albany, N. Y.	9	22.50	.			[illegible]	4.[illegible]		5.00	[illegible]
Milwaukee, Wis.	10	22.[illegible]	..	.	[illegible]	[illegible]	[illegible]	3.[illegible]	[illegible]	[illegible]
Omaha, Neb.		[illegible]	..	..	[illegible]	[illegible]	[illegible]	3.[illegible]	[illegible]	[illegible]
Allegheny, Pa.	11	[illegible]		...	4.[illegible]	[illegible]	4.[illegible]	.	[illegible]	[illegible]
Providence, R. I.		[illegible]	.		4.[illegible]	[illegible]	[illegible]	3.[illegible]	[illegible]	[illegible]
Kansas City, Mo.		[illegible]	...	. .	.	[illegible]	12.[illegible]	.....	[illegible]	[illegible]
Jersey City, N. J.	12	22.50	....	.....		[illegible]	[illegible]	.....	[illegible]	[illegible]
St. Louis, Mo.		[illegible]	.....	....		[illegible]	15.[illegible]	......	[illegible]	[illegible]
Nashville, Tenn.	13	[illegible]	..	...	. .	[illegible]	[illegible]	. ...	4.50	44.50
New Orleans, La.		15.[illegible]	.	4.[illegible]	[illegible]	8.25	14.[illegible]	4.50	[illegible]	52.25

Notes.

1. Baltimore, Md. Approximated on frontage rate, three story building 50 ft. front.
3. Buffalo, N. Y. " " " " "
4. New York Manhattan. " " " " "
6. Chicago, Ill. " " " " "
7. Brooklyn, N. Y. " " " " "
9. Albany, N. Y. " " " " "
12. Jersey City, N. J. " " " " "
2. Rochester, N. Y. Dwelling houses assessed according to valuation $[illegible]5.36=$[illegible]% of house; a house whose assessed valuation is $1,500 or less is assessed at $4.00, it is then graduated up to $7.50 according to valuation.
5. Newark, N. J. In addition to dwelling house charge and special charges as shown, there is also a charge of $1.25 for kitchen boiler.
8. Boston, Mass. Dwelling houses are assessed according to valuation. A house valued at $1,000 is assessed at $6.00 per annum, this rate is increased for each $1,000 or part thereof $1.00 per year.
10. Milwaukee, Wis. The rates charged in Milwaukee under surveys entitles the consumer to a fixed amount of water only.
11. Allegheny, Pa. Closet and sprinkling rates are figured at minimum prices.
13. Nashville, Tenn. This rate is for three persons or less, each additional person $2.00.

From this table it will be seen that for this kind of a dwelling house, Baltimore has the lowest rate, viz, $13.00 per annum; Detroit next—$13.20 per annum. The highest rate is at New Orleans—$52.25 per annum. The average rate is $28.52, sixteen cities being below and fourteen cities above the average.

The next table shows the charges for dwelling houses of one or two rooms, three or four rooms, five or six rooms, seven or eight rooms, nine or ten rooms, eleven or twelve rooms, thirteen or fourteen rooms, fifteen or sixteen rooms, occupied by one family; also charge for each additional room, as well as charges for additional families—tenement houses.

This table is as follows:

NAME OF CITY	OCCUPIED BY ONE FAMILY.								Each additional room	Each additional family	REMARKS.
	1 or 2 rooms	3 or 4 rooms	5 or 6 rooms	7 or 8 rooms	9 or 10 rooms	11 or 12 rooms	13 or 14 rooms	15 or 16 rooms			
Cincinnati, O.	3.00	4.20	5.20	6.50	7.50	8.50	9.40	10.30	0.30	2.00	Baths, Closets, etc., extra.
Milwaukee, Wis.	4.00	5.00	6.00	....	....	....	....	....	1.00	4.00	do
Cleveland, O.	3.00	3.00	....	....	....	....	....	....	0.50	Nothing	do
Columbus, O.	2.66	2.66	3.98	5.30	6.62	7.28	7.94	8.50	0.33	2.00	do
Allegheny, Pa.	2.50 for 1 4.00 " 2	5.75 for 3 7.25 " 4	8.75 for 5 10.25" 6	....	....	....	....	....	1.50	Nothing	do
Omaha, Neb.	6.00	....	....	....	....	....	....	....	0.75	do	do
Louisville, Ky.	3.00 for 1 3.60 " 2	4.20 for 3 4.80 " 4	5.40 for 5 6.00 " 6	6.60 for 7 7.20 " 8	7.80 for 9 8.40 " 10	9.00 for 11	....	....	0.50	do	do
St. Louis, Mo.	2.00	3.00 " 3 4.00 " 4	5.00 " 5 6.00 " 6	7.00	8.00	9.00	10.00	11.00	0.50	50c. for each additional person.	do
Kansas City, Mo.	3.00 for 1 3.75 " 2	4.25 " 3 4.75 " 4	5.00 " 5 5.50 " 6	6.25 for 7 6.75 " 8	7.50 for 9 8.00 " 10	8.75 for 11 9.25 " 12	10.00 for 13 10.50 " 14	11.00 for 15 11.50 " 16	0.50	When occupied by more than one family increase 20 to 55 %	do
Indianapolis, Ind.	3.00	4.00	5.00	....	....	....	....	....	1.00	3.00	do
New Orleans, La.	6.00	8.00	11.00	12.00	13.00	15.00	16.00	17.00	1.00	One-half of the regular rates	do
Minneapolis, Minn.	1.50	1.50	1.80	2.10 for 7 2.40 " 8	2.70 for 9 3.00 " 10	3.30 for 11 3.70 " 12	4.00 for 13 4.30 " 14	4.60 for 15 4.90 " 16	0.30	Nothing	do
St. Paul, Minn.	3.00	3.00	3.50 for 5 3.80 " 6	....	....	....	....	....	0.30	3.00	do
Newark, N. J.	A uniform rate regardless of number of rooms as follows: 1 family $6.25, 2 families $10.00, 3 families $14.00.									3.00	do
Jersey City, N. J.	Frontage rates in force, regardless of number of rooms; a 6 room house 2 stories high on a 20 ft. lot will cost $10.45.									2.00	do
Chicago, Ill.	Frontage rates in force, regardless of number of rooms; a 6 room house 2 stories high on a 20 ft, lot will cost $7.00.									3.00	First closet, Bath, etc, included in house rate
Toledo, O.	A uniform rate of $5.00 for one family regardless of number of rooms.									4.00	Baths, Closets, etc., extra.
Albany, N. Y.	Frontage rates in force, regardless of number of rooms; a 6 room house, 2 stories high on a 20 ft. lot will cost $12.00.									Nothing	First closet, Bath, etc., included in house rate
Brooklyn, N. Y.	Frontage rates in force, regardless of number of rooms; a 6 room house 2 or 3 stories high on a 20 ft. lot will cost $8.00.									do	do
New York, N. Y.	Frontage rates in force, regardless of number of rooms; a 6 room house 2 or 3 stories high on a 20 ft. lot will cost $7.00.									1.00	do
Buffalo, N. Y.	Frontage rates in force, regardless of number of rooms; a 6 room house 2 stories high on a 20 ft. lot will cost $3 50, also an excess rate of $1.50 per an.									2.50	Baths, Closets, etc., extra.
Detroit, Mich.	A uniform charge of $2.00 for one family regardless of number of rooms.									1.00	do
Rochester, N. Y.	Assessed according to value of building; estimating a 6 room building at $3,000 would cost $5.50.									4.00	do
Providence, R. I.	One faucet $6.00, each additional faucet not specificially rated $2.00, regardless of number of rooms.									Same as living in a separate house.	do
Pittsburg, Pa.	First room $2.00, each additional room $1.00 for each family.									According to number of rooms	do
Boston, Mass.	Assessed according to value of building; estimating a 6 room building at $3,000 would cost $8.00.									2.00	do
Philadelphia, Pa.	A uniform rate of $5.00, regardless of number of rooms or families.									....	do
Syracuse, N. Y.	A uniform rate of $5.00 for one family regardless of number of rooms.									5.00	do
Nashville, Tenn.	A uniform charge of $6.00 per annum, regardless of number of rooms, this is for 3 persons or less, each additional person $2.00.									8.00	do
Baltimore, Md.	Frontage rates in force, regardless of number of rooms; a 6 room house 2 stories high on a 20 ft. lot will cost $12.00.									Nothing	First closet, Bath, etc., included in house rate

This table, in order to be fully understood, must be carefully analyzed. Taking dwelling houses as an entirety, it is evident that Detroit has the lowest rate, there being a uniform charge of $2.00 per annum for one family regardless of the number of rooms, while additional families are charged at the rate of $1.00 each per annum. Philadelphia comes next, having a uniform rate of $6.00 per annum, regardless of number of rooms or families in the building. Minneapolis, Cleveland, Columbus and Toledo also have very low rates. The highest rate of all the cities is New Orleans, La.

The charges for each additional room in a house having over 16 rooms, runs from 30 cents per room, per annum, in Cincinnati, Minneapolis and St. Paul, to $1.50 per room, per annum, in Allegheny. A number of cities make no charge for extra rooms. Eight cities charge nothing for additional families over one. In the other 22 cities the additional family charge runs from $1.00 per annum per family in Detroit, to $8.00 per annum per family in Nashville.

Chicago, Baltimore, Albany and Brooklyn make no charge for the first bath, closet, washstands, etc., in addition to the dwelling house rates, while the other 25 cities have special charges for these privileges, in addition to the dwelling house rates.

The next table shows the charges, where same are made, for baths, closets, washstands and laundry tubs in private dwellings and is as follows:

FIXTURES IN DWELLING HOUSES—PER ANNUM.

(Where blank spaces are shown, no charges are made, the same being included in dwelling house rate.)

Name of Cities	Closets. (one)	Baths—Hot and Cold. (one)	Sta. Wash-stands. (one)	Laundry. (tray ea.)
Cincinnati	$1.50	$2.70	$ .90	$ .50
Milwaukee, Wis.	2.00	3.00	1.00	1.00
Nashville, Tenn.	6.00	8.00	....	...
Cleveland, O.	2.00	2.00	....	....
Columbus, O.	2.00	2.66	....	3.33
Newark, N. J.	2.50	5.00	....	....
Jersey City, N. J.	3.00	4.00	....	....
Detroit, Mich.	1.60	1.00	....	....
Allegheny, Pa.	2.00	3.00	1.50	....
Omaha, Neb.	2.50	3.50	1.00	1.00
Toledo, O.	3.00	3.00	1.00	1.00
Syracuse, N. Y.	5.00	4.00	....	....
Louisville, Ky.	3.00	2.50	.50	.50

Name of Cities.	Closets. (one)	Baths—Hot and Cold. (one)	Sta. Wash-stands (one)	Laundry (Trays)
St. Louis, Mo.	5.00	5.00	....	....
Rochester, N. Y.	2.00	2.00	....	....
Buffalo N. Y.	1.50	1.00	....	....
Providence, R. I.	5.00	5.00	2.00	3.00
Pittsburg, Pa.	3.00	1.00	1.00	....
Indianapolis, Ind.	3.00	3.00	....	....
Boston, Mass.	5.00	....	....	....
New Orleans, La.	6.00	3.75	2.50	4.50
Minneapolis, Minn.	2.50	2.00	.50	....
St. Paul, Minn.	2.00	2.00	....	....
Philadelphia, Pa.	1.00	3.00	1.00	5.00
Kansas City, Mo.	4.00	4.25	....	....

Chicago, Ill.—No charge for first closet or bath, included in house charge.
Albany, N. Y. " " " " " "
Brooklyn, N. Y. " " " " " "
New York, N. Y. " " " " " "
Baltimore, Md. " " " " " "

From this table it will be seen that five cities make no charge at all for these priveleges, the same being included in the dwelling house rate. The lowest charge for closets for domestic purposes is in Philadelphia, the same being $1.00 per annum. The highest is in Nashville and New Orleans, being $6.00 in each of these cities. For baths, the lowest charge is $1.00 in Detroit, Buffalo and Pittsburg, while the highest charge is $8.00 per annum in Nashville. Twenty cities have no extra charge for stationary washstands in addition to the dwelling house charges, while of the remaining ten, Louisville and Minneapolis charge 50 cents each per annum, which is the lowest, while New Orleans charges $2.50, which is the highest. Twenty-one cities have no extra charge for laundry tubs, in addition to the dwelling house charges, while of the remaining nine, Cincinnati and Louisville charge 50 cents per annum, per tray, which is the lowest, and Philadelphia charges $5.00 per annum regardless of number of trays, which is the highest.

Next is presented a short statement showing the charges for stores and business premises, which is as follows:

STORES AND BUSINESS PREMISES—PER ANNUM.

(Where no meters are attached.)

CINCINNATI, OHIO: Each place occupied wholly, or in part, as a store, office, shop, warehouse, or business of any kind, 500 square feet, or less, $1.00 per annum. For each additional 500 square feet or fraction thereof, $1.00 per annum. This price includes only one sink. Fixtures, such as closets, urinals, washstands, etc., are additional charges, according to number of people, and kind of business.

MILWAUKEE, WIS.: Stores and business premises are charges according to the business transacted and number of persons employed. The rates as fixed are for general uses only, and do not include the use of water for special purposes.

NASHVILLE, TENN.: Stores and business premises are charged according to the business transacted and the number of persons employed. Closets and baths are charged for in addition to regular fixed charges for premises.

CLEVELAND, OHIO: Stores and business premises, 20 feet front, or less, $3.00 per annum; 20 feet to 33 feet, $5.00 per annum; 33 feet to 66 feet, $8.00 per annum; over 60 feet, $10.00 per annum; closets and baths, extra.

COLUMBUS, OHIO: Stores, according to location, 20 feet front or less, $2.00 per annum; 20 to 30 feet, $4.00 per annum. Each additional foot front over 30 feet, 10 cents. Extra charge for special privileges.

; NEWARK, N. J.: Stores are charged for according to business and number of persons employed. Special fixtures extra.

JERSEY CITY, N. J.: 'According to number of feet front and height of building. Special fixtures extra.

DETROIT, MICH.: From $1.25 to $12.00 per annum.

ALLEGHENY, PA.: Store rooms from $2.50 to $10.00. Special fixtures extra.

CHICAGO, ILL.: Stores are assessed in addition to frontage rates—25 cents per annum for each person employed therein, exceeding ten; also additional charge for special fixtures.

OMAHA, NEB.: Stores are assessed from $5.00 to $15.00 each per annum. Special fixtures extra.

SYRACUSE, N. Y.: Stores $10.00 per annum. All fixtures, outside of one faucet, are charged extra.

BUFFALO, N. Y.: Stores, in addition to specific rates, $1.50 per annum and upwards.

TOLEDO, OHIO: According to number of feet front, business engaged in, number of persons employed, etc. Special fixtures extra.

BROOKLYN, N. Y.: According to frontage. Extra for certain business and fixtures.

LOUISVILLE, KY.: A minimum and maximum rate is fixed, dependent entirely upon the business engaged in. Separate charge for fixtures.

ST. LOUIS, MO.: According to business engaged in. Special fixtures extra.

ALBANY, N. Y.: Stores are assessed at two-thirds of frontage rates. See dwelling house charges.

PHILADELPHIA, PA.: Stores are assessed according to business. Special fixtures are charged extra.

BALTIMORE, MD.: Stores are assessed according to number of feet front, running from $6.00 to $10.00 per annum. Nothing extra for fixtures.

PITTSBURG, PA.: All charged according to fixtures in use.

BOSTON, MASS.: The rate for stores, etc., is determined by the number of persons employed or doing business, the charge for ten or less being $5.00 per annum. Special fixtures are charged extra.

NEW YORK: Frontage rates in force here.

NEW ORLEANS, LA.: From $8.00 to $20.00 per annum.

PROVIDENCE, R. I. Charges for stores are the same as dwelling house fixture charges.

INDIANAPOLIS, IND.: Acording to number of feet front, running from $5.00 to $15.00 per annum.

ROCHESTER, N. Y.: From $5.00 to $30.00, according to business.

MINNEAPOLIS, MINN.: Stores for sale of any goods, except liquors and dry goods, $4.00. Special fixtures extra.

ST. PAUL, MINN.: Stores are assessed according to width. Extra charges for special fixtures.

KANSAS CITY, MO.: Stores from $4.25 to $17.00 per annum. Special fixtures extra.

The next table shows the amount charged for building purposes in the cities where the same is shown on the schedule of rates, and is as follows:

RATES FOR BUILDING PURPOSES.

Name of City.	Brick per 1,000	Plastering per 100 sq. yds.	Stone per perch.
Cincinnati, O.	10c	20c	4c
Milwaukee, Wis.	6c	30c	2½c
Nashville, Tenn—No fixed charges here. Stone masons and brick masons are charged from $20.00 to $60.00 per year.			
Cleveland, O.	7 to 10c	30c	5c
Newark, N. J.	10c	35c	*2½c
Jersey City, N. J.	10c	...	2c
Detroit, Mich.	2c	5c	½c
Chicago, Ill.	5c	15c	1c
Omaha, Neb.	7c	15c	..
Toledo, O.	4c	15c	5c
Syracuse, N. Y.	6c	20c	2c
Louisville, Ky.	10c	...	4c
Rochester, N. Y.	10c	50c	4c
Albany, N. Y.	6c	...	..
Buffalo, N. Y.	†5c	20c	1⅛c
Brooklyn, N. Y.	5c	20c	..
St. Louis, Mo.	10c	50c	5c
Pittsburg, Pa.	10c	50c	5c
Indianapolis, Ind.	10c	35c	‡3c
Boston, Mass.	6½c	10½c	2¾c
New York, N. Y.	10c	40c	..
New Orleans, La.	25c	1.00	..
Minneapolis, Minn.	5c	20c	1½c
St. Paul, Minn.	5c	20c	1½c
Kansas City	8½c	33⅓c	2½c

*Per cubic yard. †Per cord. ‡Per yard.

From this table it will be seen that for building purposes Detroit has the lowest rate and New Orleans the highest.

These tables, in my judgment, give a general idea of what the water rates are in the various cities. Taken as an entirety, it is evident that Detroit has the lowest rate and New Orleans the highest.

Before passing from this feature of the paper, I desire to call your attention to a clause in the Brooklyn scale of water rents, charged against "vacant lots," which is as follows:

"Vacant lots, $100 and under—1 cent per running foot frontage.
Assessed at over $100 and not over $200— 2 cents.
Assessed at over $200 and not over $500— 5 cents.
Assessed at over $500 and not over $1,000—10 cents.
Assessed at over $1,000 and not over $2,000—15 cents.
Assessed at $2,000 and over, 20 cents.

312013

I do not find a charge of this kind in any of the other cities excepting Albany, N. Y., where a charge is made of 10 cents per annum per front foot. As to the advisability of assessing vacant property, I have nothing to say. However, a clause of this kind, strictly enforced, would no doubt realize a neat sum in almost any city, probably sufficient to justify a reduction in the rates as now existing.

It is important that the members of the Society examine the figures shown in the tables presented, in so far as they pertain to their respective cities, so that, if any of the figures are wrong, the same may be corrected before sending the copy to the printer.

I come now to the other feature of this paper. As I have already stated, in addition to securing the rates charged in these cities, it was deemed advisable to also secure data that may have a bearing on the subject of fixing rates. A series of questions were prepared and submitted to the officers of the various cities, as follows:

Question 1. Do you have a gravity supply, or are you required to pump all your water?

Question 2. In furnishing water to your citizens, do you pump directly into the supply pipes, or do you pump into reservoirs, standpipes, tanks, or towers?

Question 3. What is the pressure of water in your pump mains, and what is your suction lift?

Question 4. If you have a high service, what is the pressure in your pump main, and what is your suction lift, and what is the proportion of the water pumped by the high service to the total supply?

Question 5. What is your source of supply?

Question 6. Do you purify your water supply? If so what is the cost of purification, as compared with the entire cost?

Question 7. Are main-pipe extensions paid for out of revenues of water department, or by assessment against abutting property?

Question 8. Is interest and sinking fund on existing bonded debt provided out of water rents or by general taxation?

Question 9. What discount, if any, is allowed for prompt payment of water bills?

Question 10. Is the department self-sustaining at present? Is any money raised by taxation to maintain it?

Question 11. Are the water-works owned by the city or private individuals?

The answers received to these questions have been tabulated, and are presented with this report, marked "Exhibit A." Only a careful examination of all of the details will demonstrate what value the same may have in determining by comparison the water rates in the various cities. I shall not attempt to discuss this feature of the paper in detail, but simply give a summary of the data collected, in order that the members may more fully understand the importance thereof.

Of the 30 cities enumerated, 21 are required to pump all of their water. Four receive the same by gravity, viz., Newark, Jersey City, New York and Syracuse; while five receive part by gravity and are required to pump part of it. Two of the cites do not do any pumping at all, the gravity supply being sufficient for distribution. Ten pump into reservoirs; seven into supply pipes direct; and eleven partly direct, and partly to reservoirs, stand-pipes, etc. The importance of carefully analyzing this question in making comparisons of water rates should not be underestimated.

I shall not take up any time with reference to the third question, viz., "What is the pressure of water in your pump mains and what is your suction lift?"

This answer should be carefully scrutinized in order to determine what bearing, if any, it may have on this question.

The fourth question relates to high services, the pressure in pump mains and suction lift, and the proportion of the water pumped by the high service to the total supply. As with the third question, it is better to study this answer, with respect to the pressure and suction lift, than to try to discuss it. Of the 30 cities, 17 have a high service, while 13 are not required to repump any part of their water. The percentage of water repumped to the total supply runs from 1.9 in Philadelphia to 23¼ per cent. in Cincinnati.

Question 5 pertains to the source of supply, and question 6 to the purification of the water supply. Nineteen of the cities make no attempt at purification, some of them contending that it is not necessary; and six are now taking steps toward purification. Five of them purify their water.

Twenty of the cities pay for the extension of their water mains out of the revenues of the Water Department; three by assessment against abutting property, and eight by assessing part and paying part out of revenues, or by general taxation.

Nineteen cities provide for both their interest and sinking fund charges out of the revenues of the department; four provide for the same partly out of the revenues and partly by taxation, while five provide for the same by general taxation.

It is evident that if a water department was not required to pay for main-pipe extensions and interest and sinking fund out of its revenues, a material reduction could be made in water rents. As has already been stated, the tables show that Detroit has the lowest rate. In that city, however, the interest charges of the department, amounting to $75,000.00 per annum, are provided for by general taxation. If the department was required to raise that much more money each year, it would necessarily follow that there would be an increase in the water rents.

Another important feature is the discount allowed on water bills. Nine cities allow a discount for prompt payment, the same running as high as 20 per cent. in the city of Louisville, which, if taken into consideration, very materially affects their rate, as shown by the tables; twenty-one of the cities allow no discount, and of this number six exact a penalty if bills are not paid promptly.

All of the answers received, as to whether or not the departments are self-sustaining, are in the affirmative.

Of the 30 cities, the water-works of only three of them are owned by private companies, viz., those of Indianapolis, Ind., New Orleans and Omaha. The Louisville department is managed by a private company, but nearly all of the stock is owned by the city sinking fund.

In conclusion, I desire to return my thanks to all of those who have assisted me in securing the data for this paper, and now submit the same for your consideration and discussion.

Respectfully, A. HERRMANN.

Cincinnati, Ohio.

The paper was received with great applause.

THE PRESIDENT: Mr. Herrmann, as we discovered last year, has a faculty of going into these things very fully. It is hard for one to grasp the full meaning or significance of this paper until one has had a chance to study these tables, but there are doubtless some enquiries which the paper will suggest.

MR. VAN DUYNE, Newark, N. Y.: I was just about to say that it is almost impossible to discuss this paper without having had an opportunity to study the statistics that are given. Of course it would be an interesting study to a good many of us, to see how the different cities compare in their expenses. I may state, for the benefit of the members present, that Newark is one of the cities that obtains its water supply entirely by gravity. The source of our water supply is in the mountain section of New Jersey, and is from an elevation five or six hundred feet above the city, being from the ———— Mountain in New Jersey. The water is supplied from two different levels in the city, one the high service and the other the low service; but by gravity to each.

Company management has been to furnish water at the lowest practicable rate without making dividends upon the stock. No dividends have ever been [illegible]

THE NEW YORK
PUBLIC LIBRARY.
ASTOR, LENOX AND
TILDEN FOUNDATIONS.

The money received from consumers of water pays for extending the mains and all the other incidental expenses of the water supply; but, as I said before, we cannot begin to compare these figures until we study the different tables.

MR. M. R. SHERRERD, Newark, N. J.: I would like, Mr. President, to ask a question in regard to Detroit. Does Detroit charge. a frontage tax? The rate in Detroit seems to be the lowest rate, and the question has been brought up a number of different times as to how Detroit is able to furnish water at such a low rate. That question has been brought up in our own city.

MR. AUGUST HERRMANN, Cincinnati, O.: In answer to that question, I would say, out of the revenue of the Water Department last year and now by assessment on abutting street property they provide for extensions; and then they raise $75,000 a year for interest on their bonded debt.

MR. M. R. SHERRERD, Newark, N. J.: That is, by taxation.

MR. AUGUST HERRMANN: If they paid for those two things out of their water rents it would very materially increase their rate.

THE PRESIDENT: And yet Detroit a year ago, I believe, was seriously considering furnishing its water absolutely free, was it not, Mr. Herrmann?

MR. HERRMANN: I understand so.

MR. BERNARD SAUNDERS, Toronto, Ont.: They would put it all into taxation?

THE PRESIDENT: Yes.

MR. G. H. BENZENBERG, Milwaukee, Wis.: I have heard Governor Pingree say, when he was Mayor of Detroit, that it was his intention that the water should be free to all consumers in the city of Detroit. In arguing the matter with him in his office, I presented the fact to him that the water could not be delivered without expense, and that if water was supplied without charge and without control as to quantity, the gradual inclination would be to a tremendous waste, which would greatly increase the expense of furnishing and supplying the same, and would probably result in the necessity of increasing the size of all distributing mains in order to deliver the water which would be used or be allowed to waste without restriction, and that ultimately the citizens of Detroit would be paying a great deal more for the water, by direct taxation or in some other way, than if the consumption be kept under control and regulation and subject to a charge. However, he was very set in his views, and meant to carry his idea through the Board of Water Commissioners.

While it may appear that Detroit is offering at the present time an extremely low rate to its consumers, I believe that Milwaukee, under certain conditions, enables its citizens to obtain water at a less rate even than Detroit. It is a fact that meters have been made quite popular in Milwaukee and that now almost every house has a meter attached at the time of the introduction of the water service. Up to the present year there has been no minimum charge of any kind, nor has there been any charge for meter service, the meters being owned by the consumers. The only charge that was made to consumers was for the actual amount of water passed through the meter, and the result was that 1,833 consumers in 1897 paid less than a dollar and a half per annum; some 600 paid less than 90 cents; some 300 paid less than 60 cents, and some paid but 30 cents, while others paid but 15 cents per year.

THE PRESIDENT: Milwaukee does not make a minimum charge?

MR. BENZENBERG: There was no minimum charge. Consumers were only charged for what water the meter indicated. In the cases quoted, the consumers used the city water simply for drinking and culinary purposes—using well water, which was convenient, for washing and other domestic purposes.

This fact is stated to show that there was no restriction as to how small a quantity of water they could use, but that the consumers simply paid for what they used. The water was charged for at the rate of 20 cents a thousand gallons, or 15 cents a hundred cubic feet.

Early this year the rates were changed from a sliding scale to a flat meter rate. With 1,830 odd consumers paying less than one dollar and a half per year with meter rates at 15 cents a cubic hundred feet, it was evident that if the rates were reduced to the flat rate of 4½ cents per hundred cubic feet, as was done, the number who would pay less than a dollar and a half per year for the use of water would perhaps be quadrupled, and that the number who would be paying less than two dollars would run above ten thousand. It was therefore decided to make a separate charge, covering the expense of reading the meter monthly and of making out the bills quarterly, which was an additional burden placed upon the Water Department by the metered consumer over and above that caused by the regular rate payers, as it meant twelve visitations during a year upon the premises, and making out bills twice as frequently. The actual expense of this extra labor, amounting to about a dollar a year, was made a separate charge against every consumer who had a meter, and which may perhaps be denominated a minimum charge.

In computing the number of water-takers who would be paying less than two dollars per year for water, aside from the charge of one dollar for reading the meter, it was found to be over 11,000; and 5,900 metered consumers would be paying less than one dollar in addition to the dollar for reading the meter. With over 24,000 of the water consumers in Milwaukee having their supply controlled by meter, and about 8,500 not metered, I believe that the rates at which water is obtained in Milwaukee will compare very favorably with the rates at Detroit.

MR. SHERRERD: What is the per capita consumption?

MR. BENZENBERG: The per capita consumption is a little less than eighty gallons per day, which includes the supply of water to many domestic consumers and to several large institutions and factories outside of the city limits, the number of consumers there not being included in the population upon which the per capita rate is computed. For instance, there are a number of large consumers, such as the National Soldiers' Home, with its 2,400 inmates; quite a number of breweries; some distilleries, and the large car-shops of the Chicago, Milwaukee & St. Paul Railway, the latter supplying all of its engines with city water from tanks outside of the city. All that supply is included in the eighty gallons per capita, but the population which is supplied outside of the city is not included.

THE PRESIDENT: Do you charge those large consumers the same rate per capita as you charge the householder?

MR. BENZENBERG: Yes. The meter rate is a flat rate of 6 cents per thousand gallons.

THE PRESIDENT: Your former charge, the higher rate, must have been a very burdensome charge for your large consumers?

MR. BENZENBERG: No, for we had a sliding scale. The highest rate was 15 cents per 100 cubic feet, or 20 cents per 1,000 gallons, for the first 25,000 cubic feet consumed each year by either large or small consumer; after the first 25,000 cubic feet per year were consumed, the next 25,000 cubic feet were paid for at the rate of 10 cents per 100 cubic feet; the next 50,000 cubic feet at the rate of 8 cents; the next 400,000 cubic feet at the rate of 4 cents a hundred cubic feet, and all above 500,000 cubic feet per annum was charged at the rate of 3½ cents per 100 cubic feet. The large consumer soon obtained the benefit of the low rate and brought the high rate that he had paid for the first water consumed down to a very low average rate for the year.

MR. AMES: I would like to ask if any charge has been made to the city for fire protection and public purposes?

MR. HERRMANN: It would certainly affect it, for in some of the cities they make a charge for fire protection, and even make a charge for municipal buildings; in those cities where they do that it would certainly affect the rate. That has been taken into account in some of the cities dealt with in our report, but we could not get full answers in the others.

In Detroit the meter rate runs from 1.17 to 3.74 cents; but they have a minimum rate of 50 cents per month, which would make the smallest house rate $6 per annum. Then in Buffalo the rate is 1.50 to 4.49 cents, with a minimum rate of $24 per annum.

Then, if you take the other conditions into consideration, the city of Detroit raising its interest by general taxation, it represents quite a sum of money, taking $75,000 a year—I do not know just what their total revenues are.

MR. BENZENBERG: Perhaps it may be interesting to mention the financial condition of the Water-Works Department in Milwaukte. The department has annually paid the interest upon its indebtedness and has also retired 5 per cent. of that bonded indebtedness each year, as the law requires that 5 per cent. of the bonded indebtedness must be redeemed and called in each year, there being no sinking fund. The department has now reduced its bonded indebtedness to below one million dollars, and a large part of that will be retired in about two years more, when the 7 per cent. interest-bearing bonds which were issued in 1871 will all have been retired. At such time the department will be in condition to again reduce the rate, possible an additional 30 per cent. The department at the same time takes care of all extensions, the maintenance and operation expenses, and also has quite a sum laid aside for any emergencies or any necessary increase in the way of pumping engines, etc. In six or seven years from now the department will be practically out of debt; and as the interest and sinking fund represent at present about three-fifths of the entire necessary expenditures, the rates may then be reduced to the lowest known.

MR. ELDRIDGE: Mr. President, it struck me, when I heard that premises in Milwaukee were using only fifteen cents' worth of water in an entire year, that those premises ought to be inspected by the Health Department right away; that possibly this meter business went too far in cases of that kind. But what I rose particularly about to ask was what provision was made for flushing sewers, and if an account was kept of water used for that purpose as a charge against any civic department?

MR. BENZENBERG: In order to get at the amount of water that was used by the city in its various departments in 1897 for city purposes, accurate measurements and records were kept.

While cleaning or flushing sewers which is done by hose direct from the hydrants), a record was kept of the number of minutes the water was turned on for such purposes, of the location of the hydrants for the purpose of ascertaining the pressure at that hydrant, and of the length of hose and the size of the nozzle. This was sufficient data to quite accurately determine the amount of water that was used for flushing purposes. The amount of water used for street sprinkling purposes was determined by weighing each springling wagon when empty and when full, and the number of times it was filled each day, and the number of days each was run; and the total amount was computed from such record. The water used for horse-drinking troughs was arrived at by carefully noting the time it took the stream at each drinking trough to fill a given receptacle. This was repeated a number of times, and in that way the regular rate of flow of these constant flowing drinking troughs was determined. The display fountains were arrived at in a similar manner, by noting the pressure and the number and size of the jet openings. The amount of water used in the schools was computed by the number of times the flush tanks, whether automatic or hand regulated, dumped during the day, and the amount of gallons used at each dump. The water used in the parks for the lakes was measured, while the water used for extinguishing fires was determined from data obtained by the Chief of the Fire Department through his various foremen keeping an accurate record of the number of minutes that each engine was operated taking water from hydrants; and in case a hose was directly connected with the hydrants, of the number of minutes such hose was used, and of the size of nozzle and pressure at the engine and at the hydrants. The tanks at the natatoriums were measured and a record was kept of the number of times they were emptied, washed and cleaned during the year. In that manner almost every conceivable form in which the city used water for municipal purposes was computed or very closely estimated.

Perhaps it may be of interest to those present to state that, in order to approximately determine the amount of water used and wasted by the then 8,546 unmetered consumers, the sum total of the water that passed through all the meters for the year, the amount that was computed as being used by the city and a very liberal amount allowed for pipe leakage were deducted from the total amount of water pumped, after allowing a proper percentage for slip in the pumps, the balance being taken as the amount supplied to those whose services were not metered. I can not now from memory give the percentage accurately, but the amount that was supplied to the 8,546 unmetered consumers was very nearly equal to that used by the city plus that which was supplied to the then nineteen thousand and some hundred metered consumers, which included all breweries, factories, etc.

MR. AMES: I would like to ask Mr. Benzenberg if the city pays for the water that it is accurately determined they use.

MR. BENZENBERG: There has been an ordinance upon the books that the city should pay a certain amount for fire hydrants and other municipal purposes, but the Water Department has never received either cash or credit. It was distinctly understood, and the Council so passed an ordinance, if the rates should be reduced to a flat rate, which would very materially reduce the revenue from metered consumers, that then the department should receive credit for fire hydrants at the rate of $8 per hydrant; and for the water used by the city for other purposes, based either upon the measured amount or upon the estimated and computed amount, at meter rates. It remains to be seen whether that agreement will be carried out this fall or not.

THE PRESIDENT: There is one phase of this meter question that I wish to speak of. I do not know whether the facts gathered by Mr. Herrmann made it apparent or not, but I know it is the case in Brooklyn that where there is a limited number of meters used only by the large consumers instead of encouraging the manufacturer or large consumer, you will find if you compute the per capita consumption that the large consumer, or the manufacturer, is paying more for his water per thousand gallons than the wasteful householder who pays by the number of taps or by the front foot. It seems to me a great injustice is often done where a limited number of meters is used. I know it is the case in Brooklyn; and it has been known to exist for some time but it has not been rectified. I think that will be found very frequently to be the case where only a small proportion of the taps is metered.

MR. BENZENBERG: I do not wish to speak too often on this subject, Mr. President, but I believe I can give a comparative statement on that point; the amount of revenue received from consumers whose premises were metered was two and one-fourth times as great as that received from those whose premises were not metered, although the unmetered consumers used much more than what was supplid to the metered consumers.

THE PRESIDENT: Even with your seventy-five per cent. of metered taps you have the same injustice.

I am sure we would like to hear about the local practice in Toronto.

MR. SHERRERD: I would suggest that this would come under the head of "Report of Committee on Water Works and Water Supply."

THE PRESIDENT: I believe we have been encroaching somewhat upon the subject to which Mr. Sherrerd's committee may lay claim.

MR. HERRMANN: I differ with Mr. Sherrerd; I thought it was Assessment and Taxation.

THE PRESIDENT: If there is no more discussion upon this question we will pass to the next subject on the program, which is the "Report of the Committee on Electrolysis with some further Observations on Electrolysis in Dayton, O.," a paper which Mr. Harold P. Brown has promised to give, but Mr. Brown is not present. There is, however, a paper by Mr. H. S. Wynkoop, Electrician of the Department of Public Buildings, Lighting and Supplies, Brooklyn, New York, on "Electrolysis from the Standpoint of the Municipal Electrician," which paper, I believe, is to be read by Mr. Tillson for Mr. Wynkoop.

Mr. Tillson read this paper as follows:

ELECTROLYSIS: FROM THE STANDPOINT OF THE MUNICIPAL ELECTRICIAN.

BY H. S. WYNKOOP, ELECTRICIAN DEPARTMENT OF PUBLIC BUILDINGS, LIGHTING AND SUPPLIES, BROOKLYN, N. Y.

It almost seems necessary at the present day to offer an apology for the presentation of a paper on Electrolysis, especially if the writer comes before a technical or semi-technical assemblage, leaving his maps and remedies behind. Partly to introduce variety, largely to bring forward a somewhat neglected aspect of the situation, it has seemed preferable to present the subject to you from the standpoint of the municipal electrician, rather than from that of the electrical engineer.

In Brooklyn the conditions are very complex. There are some six hundred miles of single track, six railways power-houses well distributed, and a daily average of a little less than 1,900 cars in operation, including the motor cars of the elevated systems. Underground are gas and water pipes, railway tracks, Edison tube, cement-lined iron subway ducts unoccupied, earthenware subways containing lead covered cables, supplementary wires and bundles of old rails used as ground returns. In addition, the elevated structure itself is being made the equivalent of a ground return, through its bond connections with the track it supports. All of these conductors are jumbled together, forming an irregular network through which the stray electricity is dodging hither and thither. To increase the complication, intentional connections between dissimilar conductors have been made from time to time, at the instance of experts retained by one or another of the corporations.

In earlier days the most generally accepted method of dealing with electrolysis involved the attaching of a bond wire to the damaged spot in order to conduct away harmlessly the electricity that was causing the trouble. By means of these bonds the various corporations are caring, in specific instances, for stray currents in amounts ranging from 20 to 80 amperes.

Each corporation has its own expert watching developments, and applies its own remedies, regardless of the effect upon its neighbors of the disturbance of the electrical equilibrium thus occasioned.

The former Board of Commissioners of Electrical Subways did much pioneer work, both in identifying the cause of the trouble and in suggesting remedies. This was a State institution, however, and was at times at variance with the city authorities, so that the failure of Brooklyn to obtain relief cannot be blamed upon the Commission.

The Water Supply Department occupies a peculiar position. Since 1896 it has merely awaited developments. Tests made during that year gave indications that the cast iron mains were reasonably safe. Careful examination was then made of the pipes at the so-called danger points, and resulted in an utter failure to detect any evidences of electrolysis. Since that time no instance of damage to the city's cast iron has gone on record. Nor has any damage occurred to the cast iron of the Brooklyn Union Gas Company, a corporation controlling nearly all of the gas mains in Brooklyn. On the other hand, the Edison Electric Illuminating Company exhibits a cast iron coupling box badly corroded, electrolytically, on one side. This last cast iron was markedly different, in the appearance of its fracture, from the various samples of pipe presented.

As it is in Brooklyn, so it is in other communities. In reading the reports of experts on electrolysis, one is at once struck with the one-sidedness of the evidence. The subject is almost invariably treated piecemeal—either in its relation to the gas system, or to the water pipes, or to cable coverings, or to the street railway. Perhaps it is no exaggeration to say that to not one of these reports could properly be applied the title "Electrolysis, in Its Relation to the Public Interests in the Town of ——."

To the writer these reports, while valuable statistically, appear to involve an uneconomical expenditure of brain energy. They cover the same ground again and again, and offer partial solutions, applicable at the best to only a few of the interests affected, without in any degree comprehending in their scope the grand problem that confronts the municipality.

What part, then, does the municipality bear in relation to electrolysis? It is responsible, primarily and finally, alike for the existence of the problem and for the securing of its solution—responsible, morally, because it originally approved, by franchise, of the single overhead trolley; responsible, legally, because the public interests are jeopardized, and the safeguarding of such interests is a function of the municipality; responsible, practically, because it is generally the only body exercising authority over all of the private corporations operating within its boundaries.

How much is being done by the municipality in the way of living up to its responsibility? Generally speaking, the situation may best be summed up by quoting four stereotyped answers to complaints, these answers being much employed by city authorities everywhere:

First, to the private citizen: "O, yes, we have had a number of complaints lately about the failure of water services. If you will go to the office of the street railway and state your case, the company will in all probability pay your plumber's bill. There is no doubt but that the railway is responsible."

Second, to the private corporation: "Your corporation, as a very heavy taxpayer, is undoubtedly entitled to protection. However, we do not know as yet how to protect you. The railway people have suggested remedies that we cannot adopt without falling into legal entanglements, while several electrical men have endeavored to scare us into purchasing their patented systems or appliances. If you will engage an electrical engineer, we will assist you in every way in putting his recommendations into effect."

Third, to the Water Department authorities: "The city holds a twenty-five-thousand-dollar indemnity bond of the street railway, and that sum will cover any damage that we are likely to sustain for many years."

Fourth, to the various electrical interests: "We are laymen. We do not know anything about this. It would seem that you electrical people ought to be able to correct these little troubles among yourselves."

So long as this shifting of the burden from back to back remains in vogue, it is hardly to be expected that any great advance will be made. We ought no longer to deal so frivolously with a question involving not merely the safety of buried pipes and wires, but as well the entire matter of municipal rapid transit. If the remedy for electrolysis does not come, the single overhead trolley will have to go.

And in the place of the single overhead trolley, what? A complicated double overhead trolley; an expensive underground trolley; an experimental storage battery system; compressed air motors. The abolishment of the single trolley is a dread alternative, not to be considered seriously until every effort to overcome electrolysis has been exhausted, or until a rival to the single trolley in the transportation field has been discovered.

Granting, then, that most of us find ourselves face to face with a living municipal problem, how is it to be handled? Since it is hardly possible to combine in any one man the attributes of the expert chemist, the expert electrical engineer and the expert lawyer, the institution of a special commission is suggested. Thus, in addition to the advantage of having a number of trained minds working concentratedly upon the problem, an opportunity of technical representation on the commission is afforded to each of the affected interests. In view of the many-sidedness of the subject, a board of nine members seems not unreasonable; and the representation might properly include water, gas, electric lighting and power, electric signalling, subways, the electric railway. The electrical bureau, if there be one, of the city should be represented; otherwise the commission will find it necessary to obtain the services of a consulting electrical engineer. A chemist of reputation must not be forgotten. Chemistry is to play a larger part, apparently, in effecting the final solution than most of us realize. Legal questions, also, wil from time to time come to the surface; and to answer them a member of the legal fraternity might be added very profitably to our commission.

Kindly pardon, at this point, a digression in favor of the electric railway company. The writer's experience is that in every instance where the trolley people have been approached in a spirit of equity they have invariably come at least half way in return. Indeed, it has been necessary to officially curb their zeal in Brooklyn by refusing permission for the attachment of bonds to water mains. We feared that such permission would render the city jointly liable with the railway for all damages to service pipes past, present and future. Whether this was a sound legal argument or not, it was undoubtedly a fortunate expression of policy: for the claim was actually made by a disgruntled house owner, shortly after this refusal, that "he didn't care nothin' about the trolley; his electricity came off the water mains along with the water, and the city hadn't any right to hook wires on the water pipes and the tracks and damage poor people to help big corporations"—alluding to an instance where such bond connection had been tentatively applied a year or two before.

As far as Brooklyn's service pipes are concerned, that borough is probably not better off than is any other city. Some of the expedients resorted to in order to secure relief are ridiculous, while thoroughly effective. In one case the pipe has been carried overhead across the street, thus avoiding any near approach to the rails. In other instances heavy rubber hose has been slipped over the lead service pipes in localities where much electrolytic trouble has been experienced. Don't laugh; it is surprising how long the rubber will last, and, of course, the pipe is safe during the life-time of the hose.

The wrought iron and steel services of the gas system are attacked also and the company is suffering from an abnormal leakage of gas.

Telephone cables appear to be reasonably safe; but the electric light cables are in an unsatisfactory condition. Edison tube is suffering greatly in some places.

Coming down to cast iron we find an interesting situation. The water mains are as yet unharmed, and so are the gas mains. This is in direct contrast with the state of affairs at Dayton, Ohio, as reported by Mr. Harold P. Brown in his valuable paper of last year. Now, why is cast iron permanent in one city and so easily destroyed in another? Chemical accidents of soil, water and iron, you say; but *what* chemical accidents? Does anybody know definitely? We in Brooklyn are using a very hard, dense, even-grained, white cast iron, containing alloyed, rather than combined, carbon, and coated with some variety of asphaltic varnish. Clearly, the problem is largely a chemical one.

And that it is in reality a chemical problem is coming home more closely every day. Electrical remedies have thus far failed. The improved track return is a palliative, not a cure. The inter-bonding plan results in a ceaseless disturbance of the electrical equilibrium. The auxiliary potential method is applicable only to those towns whose electrical map is comparatively simple; and few of the larger towns come within this class to-day. The insertion of insulating sections of pipe along the line tends to throw an increased burden upon other conductors. Finally, not one of these suggested remedies offers more than a partial and temporary relief. All of them de-localize and render latent the evidences of electrolytic decay; but to just what extent is a hard matter to determine. Our volt-meter readings are undeniably valuable; and yet, after all, they are merely resultants, so that, when accepted in their true light, they afford no absolute certainty that local action is not taking place in the immediate vicinity of the test-points.

Contemplating the problem from the view-point of chemistry, however, the atmosphere seems clearer. Our civilization already boasts of bullet-proof cloth, fire-proof wood, and other paradoxes; why should we turn aside from the idea of electrolysis-proof steel, iron and lead? As soon as there shall have been discovered an alloy of pipe material that will not be attacked by the acids set free by electric currents in the soil, or a paint, varnish, lacquer or oxide coating that will absolutely protect the present steel, iron and lead, the solution of this latest municipal problem will have been effected.

H. S. WYNKOOP.

The paper was received with applause.

THE PRESIDENT: It strikes me there are some very pertinent suggestions in this paper which ought to produce some discussion. Mr. Rust, you are a member of this Committee——

MR. RUST: Mr. President, I was asked if I would act on this Committee but I have heard nothing more from it.

THE PRESIDENT: I suggested to Mr. Brown, the Chairman of the Committee, that he should communicate with you, but he evidently has not acted on my suggestion. We would be pleased to hear from you as to the local situation.

MR. RUST: So far as the city is concerned, we have very little trouble, although the telephone people are complaining, and I heard indirectly that they contemplated entering an action against the Toronto Railway Company—I do not know whether it is true or not; the Gas Company has also complained. Mr. Barrow of Hamilton might give some information on the subject, as they have had some trouble in Hamilton.

MR. BARROW: We have had very little trouble in Hamilton excepting around the Power House, where a few services have been eaten away; otherwise there has been no trouble that I know of.

MR. RUST: Mr. Keating is here.

THE PRESIDENT: I am somewhat reluctant to call upon Mr. Keating. It was suggested that one of the Electric Railroad engineers of Brooklyn should prepare a paper on Electrolysis for our Brooklyn Engineers' Club, and he replied: "Why, there is no such thing as electrolysis; if I gave you a paper on that subject I would lose my position to-morrow." I feel, therefore, that it would be unfair to ask Mr. Keating, an Electric Railway Manager, to speak publicly upon this subject.

MR. KEATING: This is a matter I heard of two or three years ago. Toronto occupies rather a unique position; we do not suffer from electrolysis here at all. From the position I occupy here I must be excused from expressing any opinion at all on the subject.

MR. BENZENBERG: That reminds me of the expression of the electrical engineer of the Milwaukee Street Railway Company while upon the witness stand. The Peoria Water Works Company had commenced suit against the Street Railway Company of Peoria for relief; and they have been taking testimony from experts on both sides throughout the country; they came on to Milwaukee to take the testimony of the electrical engineer of the Street Railway Company, and when during the examination they came to some pointed inquiries, he simply said, "I must refuse to answer that question." The testimony was being taken before a Master. The engineer continued refusing to answer a number of questions and the Master finally asked him: "Do I understand you to say that you will not answer these questions; that you refuse to answer them?" The engineer said: "I cannot answer those questions as to whether there is any electrolysis here or not. Why, if I talked on that subject at all, we would have thousands of dollars of damages to pay. I do not want to say another word on that subject." (Laughter.)

THE PRESIDENT: Mr. Thompson, you will be able to give us some specific information as to the City of Peoria.

MR. THOMPSON: The officials of the Peoria Water Company have for several years attributed the numerous breaks of the mains and services along certain streets to the weakening of same by electrolytic action and have even maintained that such action caused the failure of the standpipe on the west bluff. No agreement with the street railway companies for an adjustment of the matter could be reached, and the Water Company finally began suit to compel the railway companies to provide a proper and safe conductor for the return current. No claim was made for damages sustained, the intention of the suit being to prevent damage in the future. The water company was in the hands of a receiver, and the case is being tried before a special Master appointed by the judge of the United States Court. An enormous amount of testimony is being taken from electricians, chemists, street railway operators and water works managers. This case represents the most thorough investigation of electrolysis, its action and methods of prevention that has ever been attempted, and it will probably be carried through the highest courts and thus be of much value in solving the same problem in other places. The street railway companies at first denied the existence of electrolysis, but the evidence has been so strong upon this point that they have been compelled to withdraw from that position. The main point at issue relates to the best and cheapest method of caring for the return current. The Water Company insists upon the street car companies using a double trolley system, which they claim is the only method by which the current can be properly cared for. On the other hand, the street car companies claim this is an expensive and inefficient method of caring for the return current; and have given an estimate of the cost of poviding the lines with a double trolley. They further claim that by properly bonding the rails, and connecting the rails with the water pipe no electrolytic action will take place.

I have examined a number of service pipes, water mains and gas mains in Peoria which have been acted upon by electrolysis. The spots affected on the cast iron mains are generally covered with scales like rust, which, when kocked off, exposes a spot resembling soft graphite in color and constituency, making it very easy to perforate. The lead pipe becomes very much pitted and weakened. The greatest action appears to take place with us where the soil is sandy or gravelly. Immediately outside of the pipe, where the electorlytic action has taken place there sometimes appears a mass of sand and gravel bound together by some material forming concrete of some strength.

THE PRESIDENT: Mr. Herrmann, you have a double trolley system in Cincinnati. Is it effective in preventing trouble from electrolysis?

MR. HERRMANN: We have never had any complaint of any kind. We had one single trolley line, but it was abandoned some three or four years ago; but even when it was in operation we never had any complaint at all. Some years ago we took out a section of pipe near the power house of this trolley line and found it slightly damaged; but outside of that we have never had any trouble. The trolley lines now there are all double lines with the exception of one very short route.

MR. BALL: In conection with the reorganization of the street railway system in Washington which has come with the exception of a single line under one control during last year we understand their intention is to place underground lines within the city limits without exception, and to erect in the rest of the district the double trolley construction.

MR. THOMPSON: In the Peoria Water Company controversy the Street Car company claimed the electrolysis was caused mainly by the current reaching the main and service pipes through the stop boxes. After the trial began the Water Company replaced the cast iron stop boxes and valve boxes with sewer pipe set on concrete, thus making them non-conductors.

THE PRESIDENT: There is one far-reaching effect of electrolysis, if there be such a thing, which is going to be very troublesome sooner or later. In Brooklyn we have recently had occasion to call upon the contractors who laid an asphalt pavement, upon which the guarantee has about one more year to run, to repair the pavement which, on one side of the street, had shown signs of disintegration. In reply to the notice the contractors stated that they had taken a careful series of observations and they were thoroughly convinced that the damage to the asphalt was caused by escaping gas. They said that such a contingency as that was not contemplated in their original guarantee; that it was due to no fault or oversight in construction; and they protested against making the repairs. In reply it was claimed that the guarantee of the contractors was an unequivalent one, that there was no reservation whatever in their agreement to keep the pavement in repair for five years; that the case, as they stated it, was a hypothetical one, that they had given no positive proof that the poor condition of the pavement was due to escaping gas, and the request was renewed that the pavement be immediately put in thoroughly good repair. The reply of the contractors to the second notice was that on the advice of their counsel they declined to make the repairs on the ground that the Gas Company was clearly responsible for the damage. I have little doubt myself that the damage was caused by gas, but have maintained that the question should be fought out between the contractor and the Gas Company; and it will be a long and bitter fight. The Gas Company claims that it is not responsible, even though the pavement has been damaged by gas, for its escape is due to electrolytic action for which the railway company is to blame. I believe this is but the beginning of a long controversy, and I imagine this same question will come up in all cities, where there is a large amount of asphalt pavement. Certainly the defects in the asphalt pavements of Brooklyn that are apparently traceable to escaping gas are very noticeable. We have taken up this problem cautiously; and the matter is now before the corporation's counsel for advice as to what action it is best for the city, or the Department of Highways, to take next.

MR. SHERRERD: I might state that in Newark the trolley company directly admitted there was electrolysis; at least they went so far as to pay a large proportion of the expense of renewing the water services on one of the streets about to be paved two years ago. This street was near a power house which is not now used; but the services in the immediate vicinity of the power house had been affected by electrolysis. At first the Railway Company refused to admit that it was due to leakage of electricity from the road, and said it was due to the nature of the soil. This matter led to quite an investigation of the services, and it was found that the services in different kinds of soil were affected; finally the Railway Company made an arrangement with the Water Department, without admitting responsibility, to pay one-half of the cost of material, and all of the cost of labor for renewing the water services along that street; this cost amounted to some hundreds of dollars; and it was perhaps an equitable arrangement, because some of the services were old enough to need renewing, and an equivalent for that portion of the work was thus borne by the city.

MR. AMES: Some services were taken out in the city of Grand Rapids and were found in the same condition as those spoken of by Mr. Thompson, covered with scale, and pitted and weakened in strength. These were old pipes.

MR. W. H. BROADHURST, Chemist of the Department of Highways, Brooklyn, N. Y.: In regard to the chemistry of electrolysis, mentioned in the paper, it seems to be that the immediate cause of the so-called electrolysis is simply the action of nascent oxygen, caused by the decomposition of the moisture or water in the soil. It is the action of oxygen that causes the rusting, not the generation of acids.

MR. BENZENBERG: Last fall, during the examination of a water pipe which had given way, apparently on account of the electrolytic action upon the cast iron, the pipe was cleaned and a new condition of the metal was revealed. There were no indications of rust nor of pitting upon the surface whatever, but the metal was found to be in the condition of graphite so that with a knife a hole could be easily whittled through the iron. Photographs of these pieces of pipe were taken, but I have none with me. The exterior surface of the pipe was as smooth as it was originally, excepting that the coating had lost its gloss. This was the first time that the pipe metal was found to be in that condition. The metal in all cases of electrolysis has been soft so that when it was first taken out it could be whittled or cut, but this condition was always accompanied by more or less pitting, some of which extended almost through the pipe; but in this case there was neither pitting nor rust apparent on the outside.

THE PRESIDENT: How old a pipe was it?

MR. BENZENBERG: I cannot say exactly, but I suppose it would be all of fifteen years old.

THE PRESIDENT: It was not the soft Scotch or English iron we used to get forty years ago?

MR. BENZENBERG: No; the pipe was made either by the Addyston Pipe & Steel Company or by the Dennis Long Company.

MR. THOMPSON: Did you see that, Mr. Benzenberg, immediately when it was taken out of the ground?

MR. BENZENBERG: Yes. I was there at the time it was taken out.

MR. THOMPSON: I found a number of them, when the scale was taken off, in the condition that Mr. Benzenberg mentions.

MR. BENZENBERG: There was no scale at all in this case, nor was the surrounding ground filled with any of the iron rust or black oxide that usually accompanies this action upon water pipe.

MR. RUST: I wanted to ask whether cast welding would have a tendency to prevent electrolysis taking place.

MR. BENZENBERG: I think not. A very large percentage of the rails of the Street Railway Company in Milwaukee have been welded with the Falk joint, or the new joint.

THE PRESIDENT: The new Johnson Electric process?

MR. BENZENBERG: No. A cast iron weld; but of a different form, the patentee of which was superintendent of tracks for the Street Railway Company. After the welding of the joints a larger amount of current was found on the pipe along the line where the rail joints had been welded than previous to the welding.

MR. THOMPSON: I hardly agree with Mr. Benzenberg's position on that point. Electrolysis is caused by the current leaving the rail because of the high resistance to the passage of the current offered both by the rail and the defective bonding of the joints.

MR. BENZENBERG: I admit that.

MR. THOMPSON: If the cast-weld joint will make a better bond between the rails, it will assist in preventing electrolysis. But electrolysis is not only caused by the current leaving the rail at the joint, for it leaves the rail at every point, depending upon the resistance. The shape of the rail has some effect upon it.

MR. BENZENBERG: I wish it to be understood that I do not think the additional current was caused by the welding of the rail joint; but it is a fact that there is a larger amount of current being carried by the pipe where the same was examined since the welding of the joint than previously. Measurement at different times has made that fact evident. I do not know why it should be so. It is natural to suppose that if the rails were united by a thorough cast iron bond that the conductivity throughout the rail would be uniform, at least would not be decreased at the joint; but that it would be fully as ample at the joint as at any other part of the rail.

THE PRESIDENT: If there is no further discussion, and as this is the last paper on the program for this evening, I wish, before we adjourn, to say that the Local Committee has invited the members of the Society to take a coach ride about the city and suburbs, and the Committee would like to have this ride scheduled for Thursday morning rather than for Thursday afternoon. In making up the program I had some correspondence with Mr. Saunders, and he suggested this ride; but I did not feel at liberty to put it on the program, but thought that with the short session that has been provided for Thursday our work might be condensed into one session for that day and give us an opportunity for this ride. It is now suggested that it be taken in the morning, and if the members of the Society will not object to this departure from the printed program, I know that we should be delighted to accept the offer of the Local Committee.

Mr. Saunders says that the coaches will be ready at half past nine on Thursday morning in front of this building.

MR. SHERRERD: I have been trying to get in communication with Professor Leeds and Mr. Allen Hazen, who are down for papers for to-morrow evening; but I am very much afraid we shall be disappointed as to these papers, because I have not heard from either of them. I telegraphed yesterday, and learned that Professor Leeds was in Philadelphia. I would suggest that if some of the papers that are down for Thursday morning could be given to-morrow evening, this would leave us more time for the ride on Thursday morning.

THE PRESIDENT: There is quite a large number of papers scheduled for to-morrow (Wednesday) afternoon, and it is possible that, with the discussions, we can not finish our program, and it might run into the evening. Perhaps Dr. Woodward would not object to having his paper, which is scheduled for Thursday morning, put on for to-morrow evening.

DR. WOODWARD: It is entirely immaterial.

THE PRESIDENT: Mr. Herrmann has a paper on the same subject.

MR. HERRMANN: Mine will only take five minutes. It is in connection with Dr. Woodward's paper.

THE PRESIDENT: I hope the members will understand that the program is subject to change without notice.

On motion, the meeting adjourned to Wednesday morning, the 4th inst., at 10 o'clock at the Union Station, to participate in the trolley ride.

SECOND DAY—AFTERNOON SESSION.

Wednesday, 4th October, 1899, 2 o'clock p. m.

The President called the meeting to order.

THE PRESIDENT: The afternoon is to be devoted to the report of the Committee on Street Paving, and to a number of papers which have been prepared on this subject. As there are a number of papers which we propose to try to get through with, in order to save time it will be advisable to follow the custom which has prevailed at former conventions—that is, to postpone all discussion until all the papers on the subject have been read; and I would suggest that the members make such memoranda as they wish during the reading of the papers, so that the subject may not escape their minds. There will be ample time for discussion.

Mr. Fisher read the report, as follows:

REPORT OF THE COMMITTEE ON STREET PAVING.

BY EDWIN A. FISHER, CITY ENGINEER, ROCHESTER, N. Y., CHAIRMAN.

TO THE PRESIDENT AND MEMBERS OF THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS:

GENTLEMEN:

Your Committee on Street Paving has given attention during the year to various details of the subject, and has endeavored by correspondence and personal solicitation to obtain papers of interest to the Society. While the responses have not been as general as was desirable, it is hoped that the additional time thereby available for the discussion of the various subdivisions of the subject will be fully utilized by the members present.

Your Committee of last year gave special attention to the following four heads under the general subject of "Street Pavements":

1. The Selection of Paving Material.
2. Railroad Track Construction in Paved Streets.
3. The Obligations of Street Railroads and Other Corporations as to Maintenance of Pavements between their Tracks, and over their Sub-surface Constructions.
4. Regulations to Restrict and Control the Opening of Pavements by Corporations, Plumbers and Others.

In the opinion of your Committee the subdivisions above given cover a field of investigation so extensive and of such permanent interest to the members of the Society that the time given to the report of your present Committee cannot be better employed than in following out the lines of investigation suggested under the foregoing subdivisions

The first two subjects received attention both in papers and discussions at our last Convention in Washington, and are fully reported in the "Proceedings." It is not our purpose to again go over the ground so well treated before. It is of interest, however, to note that the conclusions stated by your former committee with respect to permanent track constructions in paved streets receive the sanction of both municipal and railway officials, and the construction recommended is being very generally adopted. In the city of Rochester, N. Y., a large amount of paving was done in streets occupied by street railway tracks during the year 1898, and a much larger amount is now going on. All of the permanent track work, and the pavement, are of the most durable construction, and fully in accord with the principles stated by your former committee. Some special features of track and pavement construction adopted in that city will be described and illustrated by the speaker during the discussion which it is hoped will follow this report.

The subjects relating to the obligations of street railways and other corporations as to maintenance of pavement between tracks or over the sub-surface constructions, and the regulations to restrict and control the opening of pavements by corporations and others, were not considered at our last meeting. Your Committee, therefore, asks your attention to a brief consideration of these questions, and hopes for a full and free discussion of the conclusions that follow.

The question of the municipal ownership of water works, street railways, gas and electric lighting, telephones, and other forms of industry closely related to the municipality, is now attracting almost general attention. During the recent session of the League of American Municipalities, at Syracuse, N. Y., several sessions of a very largely attended convention were given up to the discussion of this subject. A large number of papers were read forcibly presenting both sides of this question. This phase of the problem, we, as municipal officers, can well leave to the consideration of that Society.

The manner in which the streets are to be paved and kept in repair, in connection with street railways, gas and electric subways, and other public utilities, we can very profitably consider.

The so-called repair gangs of these corporations, together with the openings made for water services and lot laterals, can and do destroy pavements more than all the legitimate wear to which they are subjected.

The street railways have more to do with street pavements than any other of the public services. The mileage of all street railways in 1898, in the United States and Canada, is given in the Street Railway Journal of February, 1899, at 17,964 miles, having a capitalization of $1,650,000,000. Assuming that 25 per cent. of this mileage is outside of city streets, the balance, 13,473 miles, has, within the rails and 2 feet outside thereof, about 71,000,000 square yards of pavement. Assume the cost of pavement at $2.00 per square yard, we have the enormous sum of $142,000,000 as the first cost of this pavement.

What is the best method of making, and keeping in repair, permanent pavements in the streets occupied by railway tracks, having reference to the rights and duties of both the railway company and the municipality.

Several methods are in use for accomplishing this end. First, and most general, when the railway company is under obligation to pave, and repair that pavement, between the rails and for a specified width outside thereof. As a rule, the general Acts and special Charter provisions relating to this matter are so vague as to be the cause of constant controversy between the municipal and railway officials. For example, the General Street Railway Law of the State of New York, as amended by Chap. 676 of the Laws of 1892, reads as follows, with reference to "Repairs of Streets":

"Every street surface railway corporation so long as it shall continue to use any of its tracks in any street, avenue or public place in any city or village shall have and keep in permanent repair that portion of such street, avenue or public place between its tracks, the rails of its tracks, and two feet in width outside of its tracks, under the supervision of the proper local authorities, and whenever required by them to do so, and in such manner as they may prescribe. In case of the neglect of any corporation to make pavements or repairs after the expiration of thirty days' notice to do so, the local authorities may make the same at the expense of such corporation."

The operation of this law in the city of New York is shown by the following quotation from a paper on "The Influence of Rails on Pavements," by Edward P. North, then Water Purveyor of said city, published in Vol. 37 of the "Transactions of the American Society of Civil Engineers." He says: "The laws of the State of New York make it obligatory on all surface roads to pave and keep in repair the space between the rails and tracks, and two feet outside of the same, but it provides no adequate penalty for non-compliance with the law. The only recourse known in the city of New York is to pave the space and charge it to the railway company, or to leave the area to the public spirit of the corporation. The latter method has resulted in a pavement on a portion of Eighth Avenue between the rails that is seldom used by the most stolid truckman, while the space between the tracks defied traffic of all kinds. The other method has resulted in bills aggregating decidedly over $700,000 accumulating against the surface railways of Manhattan Island from 1889 to 1895, inclusive.

In the city of Indianapolis, Ind., the railway company is obligated to repair existing pavements, but not required to lay new pavements. There, even a more unsatisfactory condition with respect to pavements in the street railway tracks seems to exist. It is stated that the condition of the streets between the tracks is very poor, and even dangerous, and is a source of constant irritation to the citizens.

In the city of Rochester, N. Y., the railway company accepted the conditions of the statute, so far as repairs to the pavements were concerned, but did not admit its obligation to make new pavements. In October, 1898, a decision of the Court of Appeals was given in the case of John Conway against the city of Rochester, in the Lyell Avenue pavement matter. In this case the Common Council adopted an ordinance for an asphalt and block stone pavement in this street. The entire cost was directed to be assessed against abutting property. John Conway, a property owner, applied for, and was granted, a temporary injunction, restraining the Executive Board from letting the contract. Subsequently an order was granted vacating the injunction and an appeal taken from that order to the Appellate Division, which affirmed the order. An appeal to the Court of Appeal was then taken and the two following questions were certified by the Appellate Division: First, Are the abutting owners on Lyell Avenue liable for the cost of constructing a new pavement between the tracks, the rails of the tracks, and for two feet in width outside of the tracks of the Rochester Railway Company? Second, Is the duty of the Common Council of the city of Rochester to request the railway company to construct a pavement between its tracks, the rails of its tracks, and for two feet outside thereof, on Lyell Avenue, before the city constructs such pavement, mandatory?

The Court decided the first question in the negative, and the second question in the affirmative. In the opinion accompanying the decision it was held that the local authorities may determine when and how the street shall be repaired, but when that is done, the statute steps in and says the railway company is to do the work.

In the case referred to the railway company was not made a party. The result is not accepted by them as final, and the case in a different form is now on its way through the courts. In the meantime the railway company refuses to carry out the directions of the Common Council with respect to paving, and the work is now being done by the city authorities in connection with the pavement of the balance of the street, and bills for the most made against the railway company. The managers of the company, while denying their liability to pay for the pavement and foundations, have co-operated with the city officials generally in securing the best form of rail and the most solid track construction possible. The result is a pavement uniform in quality for its entire width. The heavy grooved rails resting upon a solid concrete foundation offer the minimum resistance to the full and free use of the street by the public. The long guarantees and solid track construction will also operate to relieve the railway company for years to come from any cost for repairs to these pavements, and also reduce to the minimum, if not quite eliminate, track repairs also.

This situation, as respects the physical conditions of the problem, is satisfactory alike to the citizens and the railway officials.

It may be stated in this connection that the present satisfactory method of construction is not the result of the previously quoted Conway decision, but rather of the dissatisfaction of the city officials, the public generally, and the railway officials also, with the two or three specimens only of repaired pavement between tracks in permanently paved streets within the city. During the years 1897 and 1898 an agreement was entered into between the manager of the railway company and the city, through the Common Council, by which the city was to do all the work of paving certain streets and constructing the foundations, and the railway company was to pay a portion of the cost, in lieu of repairing the existing pavement.

The result of the Conday decision was to make null and void all such agreements. Special acts were passed by the legislature authorizing the assessment of the entire cost of the work between the tracks, and for two feet outside thereof, upon the railway company. The conditions here stated demonstrate clearly that it is to the mutual advantage of the municipaliy and the railway company that all pavement work be done by the municipality, and, where possible, by the same contractor.

The second plan is for the municipality to take entire charge of the street paving and repairs, the railway company paying a direct tax for the use of the street. Perhaps the best and the most perfect illustration of the undivided care of streets having car tracks is within your observation, in the city where we are assembled. Here the city builds the roadbed to receive the railroad construction and receives a rental of $800 per mile of single track, together with a tax on gross earnings for the use of the tracks and the franchise. It is hoped that in the discussion the details of this method will be very fully brought out by the local members.

In Philadelphia the conditions with respect to paving are the reverse of those existing in this city (Toronto). There the railway company has since 1892 paved and maintained the streets in which they operate cars from curb to curb. (The length of streets occupied exceeds that of any other city, due to the fact that in most streets only one track is allowed. The cars generally run in opposite directions in neighboring streets.) Up to December 31, 1897, 226 miles of permanent pavement, mostly asphalt, have been laid entirely at the expense of the company, the cost of which is estimated at $12,000,000. The street work has been done under the general supervison of the Department of Public Works by contract. Although the relations between city and railway officials have been generally satisfactory, the Director of Public Works recommends that hereafter all street construction be done by the city authorities, and the expense thereof charged to the companies. He is of the opinion that there should be no division of responsibility as to street constructions and repairs.

A committee appointed by the Governor of Massachusetts investigated the relations between cities and towns and street railway companies in the years 1897 and 1898. This committee was composed of Charles Francis Adams, William W. Crapo and Elihu B. Hayes, with Walter S. Allen, clerk. The investigation was most thorough and comprehensive, covering existing conditions generally in America and Europe. The high character of the members composing this committee, and the reputation for thorough and effective pioneer work by the state of Massachusetts in investigations relating to matters of public concern, should give much weight to the conclusions of this committee.

Massachusetts also has within its comparatively small area 1,644 miles of street railway tracks, or over 9 per cent. of the entire mileage of the United States and Canada, the amount being exceeded by only two other states, viz: New York standing first with 2,293 miles; Pennsylvania second with 1,693 miles; Massachusetts being third with 1,644 miles. The total mileage of the United Kingdom Company of England, Scotland, Ireland and Wales is given in said Massachusetts Report in 1896 as only 1,468 miles, or nearly 200 miles less than the mileage of Massachusetts. Mr. Robert P. Porter also states that the entire mileage of all Europe, with a population of over 400,800,000, was about 7,500 miles, which is 1,000 miles less than the combined mileage of the five states of New York, Pennsylvania, Massachusetts, Ohio and Illinois.

The Committee in its report to the Legislature says: "Reference has been made to three lines of ultimate development into which the relations of street railway interests and municipalities seem now in this and other countries to be naturally working: (1) That of regulated private ownership; (2) that of the municipal ownership of a permanent way to be operated by a private company as lessee; and (3) municipalization. The first of these lines of development is that which through the street railway interests of the commonwealth have grown up, and its advantages and defects are well understood. The chief objection to it is obvious—it necessarily involves a divided control of streets, resulting in continual jealousies, misapprehensions and disputes. While, because of its simplicity, as well as from the analogy of the steam railroad, it naturally suggested itself in the early and experimental stages of street railway development, it certainly does not now commend itself as a permanent or scientific arrangement. Even should it be continued indefinitely, the Committee is clearly of opinion that it would be conducive to a better state of affairs were the municipalities to assume full control of the streets, meeting all charges for paving, for street cleaning, etc., and receiving therefore from the companies a net annual money payment in lieu of work in kind. This would be in the nature of a commutation—a pavement and cleaning tax to be paid by the company in consideration of the special provision made in streets for its exclusive use.

The Committee submitted drafts of proposed laws embodying the conclusions arrived at in their report, and during the last summer the statute went into effect.

The general tenor of the report of the Massachusetts Committee was strongly and unequivocally in favor of an undivided care and control of street pavements by the municipality, the question of compensation from the railway companies being taken care of by direct taxation.

The rapid progress now going on in automobile construction may soon result in placing upon the streets of our cities lines of these carriages in competition with existing street railway lines. In justice to the community and to the vested interests of the street railway, this new industry should contribute its proper proportion toward the improvement and care of streets through which it may operate, not by doing any part of the work and thus creating more confusion, but by the payment of a direct tax applicable to said construction and repair.

Your Committee in this discussion has purposely left out all reference to the method of taxation, or the amount to be charged the railway companies, in lieu of making pavements and repairs, as this will have to be adjusted to the conditions existing in the various localities.

Your Committee would respectfully submit as its final conclusion upon this subject, that the construction and repair of pavements in all streets, whether occupied by railway tracks or otherwise, should be directly under the control of, and done by, the municipal authorities, and that where existing laws do not permit of this being done, an effort should be made to have said laws so amended as to permit of the work being so done, the compensation to the city for use of streets to be made by a direct tax, instead of the indirect method of requiring work to be done.

Your Committee would also recommend the consideration of the plan of the city, in some cases, owning the track construction in paved streets, and charging the railway company operating over the tracks a rental, as recommended in the Massachusetts Report previously referred to.

With reference to street pavement openings, the magnitude of this cause of destruction of pavements is well illustrated in the report of the Department of Public Works of the city of New York for 1896, in which it is stated that one mile in four of our paved streets was torn up for construction purposes during the year. In addition over 59,000 separate openings requiring repairs to pavements were inspected by the department during the year, so that in addition to one-fourth mile of trench opened for every mile of paved streets, there was another opening every 35 feet.

Attention is also called in said report to the unsatisfactory work done in refilling excavations, and to the defects in existing laws relating to the subject.

The City Engineer of Montreal says, "a great source of weakness to the pavement are the numerous excavations made in them for gas, water and drain purposes."

In the City Engineer's report of Peoria, Ill., for 1898, Mr. Thompson says: "The pernicious practice of allowing the pavements to be torn up for making service connections has continued during the past season. There is no agent so destructive to the life of pavement as this continual tearing up and consequent patching involved."

Mr. S. J. Fields, former City Engineer of Buffalo, N. Y., says, "Without fear of contradiction, I venture the assertion that more pavements have been ruined by lack of care in refilling trenches and carelessness in replacing pavements, than have been worn out by traffic."

In the city of Cleveland, the City Engineer says, in report for 1897: "The putting in of all necessary sewer and water connections to curb line in advance of paving of any street or alley is made compulsory when ordered by the city, and if not put in by the owner after due notice, usually 10 days, the work is done by the city and charged against the lot owner and is paid with his other taxes. These connections are put in by licensed sewer builders and are inspected by city inspectors. The price for inspection is $1.50. The price should be $3.00 for each permit. The city should then do the puddling of the trenches. This puddling is now imperfectly done by the sewer builder, or often not done at all, and is thereafter a source of complaint from the paving contractors who must guarantee the pavement he lays over it. All water connections are in charge of the Waterworks Department."

"A careful examination of 36 streets to be paved showed 5,256 connections, both water and sewer, required. Only 3,657 connections were found already in; 1,599 new ones were required. The property owners put in 1,559 of these connections and allowed 40 to go delinquent, being a little more than 2½ per cent. of the number to be put in. Of the 1,790 voluntary connections put in during the year by owners, only 75, or a little more than 4 per cent., were put in where pavement had to be disturbed. This shows the wisdom of requiring all connections to be made before pavements are put down. All repairs to pavements for the above work are made by the city, and the expense charged directly to the sewer builder or plumber, and by them to the property owner."

In the city of Rochester the Common Council has authority to include in its pavement ordinances all necessary water services and lot laterals, and to assess the cost thereof to the owner of the property served. Corporations having, or requiring, subways, are required to put in all underground work in advance of a new pavement. The guarantee for new pavements makes it the duty of the contractor to replace the pavement on all excavations, and requires him to guarantee the same for the balance of the term. It also prescribes the amount he may charge for said work. In this way, by careful supervision and the disregard of the specious plans of short-sighted abutting owners for temporary relief, by omitting needed consructions, the minimum disturbance of new pavements may be secured.

The conclusion of your Committee on this subject is:

1st. That previously to the paving or repaving of a street all underground work of any kind that will probably be required within the life of the pavement be put in, as far as possible, and that the work of backfilling all trenches in a street under improvement be done, wherever possible, by the contractor who lays and guarantees the pavement; or if the work cannot be done by the said contractor, it should be done subject to his inspection and approval, as well as that of the municipal inspectors.

2d. That no excavations of any nature, except for emergency repairs of existing pipes and fixtures, shall be permitted in any street except upon the written application of the individual or corporation desiring to make said excavation, and the filing of a proper indemnity bond. All work, except repaving, to be done by licensed contractors under the immediate supervision of inspectors employed by the municipality. The repaving to be done either by the city or by the contractor guaranteeing the pavement, when the same is under guarantee. All costs of inspection and repaving to be paid by the owner or corporation desiring the service. Said costs to include guaranteeing the pavement replaced for three years. Respectfully submitted,

E. A. FISHER,
Chairman of Committee on Street Paving,
For the Committee.

THE PRESIDENT: The next paper on the program is one on "The Life of Pavements," by George W. Tillson, Principal Assistant Engineer, Department of Highways, Brooklyn, N. Y.

MR. TILLSON read report No. 9 as follows:

THE LIFE OF PAVEMENTS.

BY GEO. W. TILLSON, MEM. AM. SOC. C. E., PRIN. ASST. ENGR., DEPT. OF HIGHWAYS, BROOKLYN, N. Y.

When one seeks to purchase a new article the first question usually is, what does it cost? And if it be subject to wear there immediately follows, how long will it last? And, although asked second, this latter question can hardly be said to be of secondary importance. For while the first cost of an article may determine one's ability to buy it, it does not by any means settle its economy, for what is cheap to obtain at first is often most expensive in the end.

So when it comes to the selection of a paving material the question of durability is of the utmost importance. What is the life of a particular kind of pavement? The question is often answered off hand by the tyro positively, and with little hesitation, but the engineer of experience who has seen a pavement last a certain time on one street, and twice as long on another, has seen the result of this condition here and another there, gives his reply hedged in by so many provisons that at first sight it would seem to be of little value. But when it is carefully studied the discovery is made that these restricting conditions are just what are required to adapt the reply to any particular case that may happen to be in point.

To the study then of the varied conditions affecting the life of a city pavement this paper will be given.

The two great agents that tend to destroy a pavement are traffic and atmosphere. The former is variable, and its effect varies directly according to the amount applied under certain conditions. The action of the latter is constant, depending somewhat upon the climate, but principally upon the nature of the paving material.

Traffic and the atmosphere act positively, and their results can be measured. At the present time it may be said that there are four materials being used in street pavements—stone, brick, asphalt and wood. The action of traffic and the atmosphere is very different upon these materials as affecting durability. It is safe to say that the life of stone and brick (taking it for granted that none of their kind of a quality to be acted on by the air would be used) in a pavement depends, other things being equal, directly on the amount of traffic they sustain, but that statement would not be true of asphalt and wood. For should the traffic be light the life of the pavement would be ended by the action of the atmosphere. Asphalt not to such an extent as wood, but it is well known that an asphalt pavement deteriorates materially under the oxidizing effect of the air, even if it have little or no traffic.

It must be remembered, also, that there are two ends to all pavements, the physical and economic end. The former comes at a time when the pavement is so worn out that it cannot be repaired and must be entirely relaid, the latter when the cost of repairing is such that it will be cheaper to relay it entirely than to spend any more money on repairs. These two ends do not necessarily come at the same time. The former test will generally be applied to stone, brick or any block pavement, and the latter to asphalt or macadam. When a pavement is made up of moderately sized parts of practically the same character and texture, the wear on these parts is approximately the same and the repairs necessary are generally relaying old material, rather than furnishing new. But when the pavement is made up of parts so small that they must be consolidated into a continuous whole before they can be available, it is different.

The physical end of a pavement can be determined by observation. Blocks wear on account of the abrasion and impact. Granite wears in two ways, by chipping and rounding off of the corners, and the gradual grinding off of the blocks under the friction of wheeled vehicles. When the blocks are of the harder granites or traps the former action takes place. The softer granites and the sandstones wear down smoothly with flat surfaces, and in time the blocks actually become worn out, the pavement becomes rough, horses stumble, and it is soon seen that the street should be repaved.

Asphalt and macadam wear away, and new material can be added in large or small quantities as may be desired, and the physical life of the pavement prolonged indefinitely. It is then that the economic test is applied to ascertain when the pavement should be renewed. Assume that a street is paved, but the expense of keeping it in good condition is considerable, and this question arises, shall the repairs be continued, or shall an entire new pavement be constructed.

Let N=Life of proposed pavement.
C=Cost.
I=Rate of interest.
R=Estimated cost of repairs if distributed over entire life.
A=Sinking fund to be paid each year to equal.
C at end of N years, then

$$A+CI+\frac{R}{N}=\text{Annual cost of a new pavement.}$$

Take, for instance, an asphalt pavement, and let $N=15$; $C=1.50$; $I=3\frac{1}{2}$; $R=\$0.40$. A will $=.0807$, and the equation becomes $.0807+.0525+.0267=\$0.1599$, or if the street be repaved it will still cost annually \$0.16 until it is renewed. It must rememberd that C is equal to first cost, less the value of foundation and other material, if any, at time of renewal. From the above it would seem that it is economy to repair an asphalt paved street, rather than to repave it when the cost of repairs is much less than \$0.16 per yard, provided the assumption of 15 for a value of N is correct. If there is any error in the other values they must be too small, rather than too large.

Let then $N=20$, other values being the same (R being obtained by taking a guarantee period of five years, and assuming cost of repairs four cents per yard per year for remainder of life), and the equation will become $.0531+.0525+.03=\$0.1356$ as the annual cost when N is taken at 20 instead of 15. The author believes that this is the engineering, the scienific and the only true way of determining when an asphalt pavement should be relaid. The only element to modify this principle is the inconvenience business men and merchants may be put to by having repairs made on a street too frequently (3). The determination of this must be a matter of judgment, to be applied in each particular case. But the principle of the formula is right and when cities have had a few years' more experience with asphalt there will be no trouble in determining the true values of the variables.

Coming down now to the actual conditions by which traffic is modified in its action on pavements, it will be seen that there are five, viz: character of the pavement, width of roadway, presence or absence of street car tracks, state of repairs, and how well cleaned.

The one great agent that acts upon a pavement is, of course, the traffic that passes over it. This is very hard to measure, and very few attempts have been made to do so in the United States. The custom has been to speak of heavy, medium and light traffic streets with but a very vague idea of what these terms meant. Forgetting, too, that as so used they are only comparative, as medium traffic in a large city would generally be heavy traffic in a small one. Traffic has generally been measured in this country by assuming a certain weight for vehicles of different description, and by counting the passage of the vehicles on a street during a given time thus arrive approximately at the amount of tonnage passing over it. The results are generally given without regard to the width of roadway, making it very difficult to compare results arrived at in the different cities. In England attempts have been made to reach more scientific results, and the tonnage per yard of width of roadway per day or per year has been taken as the unit. This enables one to compare directly the traffic of one city with that of another, although it must be remembered that the passage of ten vehicles weighing one ton each registers the same as one ten-ton truck, when it is probable that the latter would do much more damage than the former. This method, however, is probably as definite as is practicable.

In 1885 Gen. F. V. Greene had a series of observations taken in many of the principal streets of the leading cities of this country to determine the amount of traffic. The total number of vehicles passing between 7 a. m. and 7 p. m. was counted. The following are some of the results, the largest number being given in each case so as to give an opportunity for comparison:

Broadway, New York	7,811
Broad Street, Philadelphia	6,081
Devonshire Street, Boston	5,362
Douglass Street, Omaha	4,752
Fifteenth Street, opposite Treasury, Washington	4,520
Clark Street, Chicago	4,389

While the author would not state that an ttempt was made to get the heaviest traffic street in each case, persons familiar with these cities will recognize that they are representative streets.

In Paris the vehicles passing on the following streets in twenty-four hours were:

Rue de Rivoli	42.035
Avenue l'Opera	29,500
Rue Croix des Petit Champs	20,480
Rue St. Honoré	19.672

And in London:

King William Street	26,793
Gracechurch Street	15.585
Queen Victoria Street	16,531
Cheapside	15,206
George Street, in Sydney, Australia	11,960

Great Howard Street, Liverpool, sustains a traffic of 216,000 tons per yard of width per annum.

Showing very plainly that the pavements in the large European cities are subjected to much more travel than those of this country.

Width of Roadway—The distance between curbs affects traffic, as it tends to scatter or congest it. If a street is to sustain a certain amount of tonnage, the greater surface it can be spread over the less it will injure the pavement. This is also true when the load is reduced to a unit of width, especially if the roadway be small and the traffic continuous. In a narow, well- traveled street the carriages and trucks move in well-defined lines, one behind the other, so that it is impossible to scatter it and subject the entire surface to anything like uniform wear. Ruts are worn in the pavement, and the time comes for its renewal long before it would have, could its work have been distributed evenly over it.

Character of Pavement—By this is meant the detailed method of its construction. The laying of asphalt has been practically standardized, and there is not much difference in the methods of the different companies. But granite, brick and wood vary much as to foundation and joint filling. Wood, too, is often treated chemically so as to entirely do away with the climatic action, and this renders it necessary to study it from the standpoint of traffic only. Different kinds of wood are used in different sections, each having a different life as a result of the physical as well as the chemical action.

To obtain the best results from a block pavement it should be laid in such a manner as to receive the traffic vertically upon the face of the blocks, and so substantially that the blocks will maintain their position while in use. To accomplish this the foundation must be such as to sustain the loads liable to be imposed upon it, and the joints filled with some firm and enduring material. This is necessary for two reasons—to keep the blocks in position and to prevent water from reaching the foundation and injuring it. While the fulfillment of these conditions adds to the expense, the life of the pavement is prolonged sufficiently to more than compensate for it.

Presence or absence of a street car track—A street car track has a great bearing on the action of traffic. It concentrates travel, and in a street where the tracks are infrequent use practically reduces the roadway to the space outside the rails with all and more of the evils of a roadway of that width—more because there is almost no opportunity to get out of the regular route by using the center, which sometimes happens in a roadway without tracks as wide as the vacant space. True, much travel is accommodated on the rails, but the gauge of the heaviest tracks is greater than that of the cars, so that one wheel runs on the pavement, and being confined absolutely to the same place, soon wears a rut in the hardest blocks.

In the fall of 1896 Kent Avenue, Brooklyn, was paved with the best granite that comes to the New York market, on a Portland cement concrete base, with tar and gravel joints. This street is probably subjected to as many heavy loads per day as any street in Greater New York, is 36 feet wide and has a double line of street car tracks. On one side of it are the big sugar refineries, which send daily over this pavement in their busy time some 1,000 or 1,200 loads of sugar, weighing about eight tons each (4). It seems almost impossible for the teams to travel without the wheels of one side being in a car track. This brings those of the other side about eighteen inches from the corresponding rail. After the pavement had been thrown open to traffic for six months a rut perhaps an eighth of an inch deep was worn in the blocks, and on the cross-walks was plainly visible. The sugar companies who had paid one-half of the cost of the pavement made a strong effort to scatter the teams, sending men on the street for this especial purpose. But it was only driving the wheels from one rail to another, and soon other ruts were formed; and to-day, after three years' service, ruts from ¾ inch to 1½ inches deep are found in several places. Contractors understand this fact, and where the guarantee is required for any long period, bid appreciably higher for pavements on street car streets (5). In 1897 bids for asphalt pavement in Brooklyn on 68 streets free from tracks averaged 0.98 per square yard, and 1.26 per yard on 11 streets where the tracks were present. Few cities have kept their repair account so that this extra cost can be gotten at exactly, but in an article read before this Society at its last session Mr. Guthrie showed that it was $0.148 on business and $0.047 on residence streets with street car tracks, and $0.112 on business and $0.048 on residence streets without tracks in the city of Buffalo for asphalt pavement (6).

State of Repairs—The condition in which a pavement is kept as to repairs is of vital importance. If holes, depressions or other defects are allowed to remain for any length of time, the material is abnormally worn and blocks rounded off to an amount probably four or five times what they would have been had they been in their normal position. Few officials who have the maintenance of pavements in charge appreciate this; but should they examine granite blocks or bricks that have been loosely paved in a trench and allowed to remain there for some time sustaining their usual amount of travel, they will surely be convinced. If this be true of the hard block pavements, how much more so is it of such materials as macadam and asphalt. Watch a small hole in either of these pavements and see how rapidly it increases under traffic if it receive no attention, and how much more it costs to repair it after a few weeks of neglect, and it will be seen how rapidly neglect in this respect tends toward the economic end of any pavement, but particularly one of asphalt or macadam.

Cleanliness—At first thought it may seem that this does not have much to do with the action of traffic, but a little reflection will soon dissipate that idea. When a pavement is clean the wheels and the horses' hoofs bear distinctly on the paving material, and it must sustain the entire friction, and its reaction wears out the pavement. If, on the other hand, it be covered with a cushion of dirt, the pavement acts principally as a foundation. The author once inspected a brick pavement said to have been down five years and to be in as good condition as when laid. It was in a small town where the streets were seldom cleaned, and an inch or more of street refuse had to be scraped off before the surface could be seen.

An advocate of a particular brick for paving purposes, in describing a pavement of it which he had recently examined, naively said: "When I dug down to it I found it just as good as it ever was."

It is said that when the Forum Trajanum was cleaned by the French in 1813, the ancient Roman pavements were found in good condition under some twelve feet of rubbish. While this is probably an extreme case, it is very likely that a modern pavement of imperishable material would have a long life under such conditions. At the last meeting of the National Brick Manufacturers' Association, when the question of how to minimize the noise of a brick pavement was being discussed, a member arose and gravely asked if our cities did not keep our streets too clean; if brick pavements would not last longer and make less noise if a cushion of dirt was allowed to remain on them. Although the question was answered in the affirmative, it was decided that officials in large cities would keep the streets clean even at the expense of the brick pavements. Asphalt and wood, on the contrary, should be kept clean in order to add to their durability, as rubbish of any kind collects moisture and so hastens the decay of these two materials.

The action of the atmosphere is shown under the examples given of the life of several wood pavements.

Having now somewhat hastily discussed the different influences that modify the action of traffic, it will be in order to take up the different kinds of pavements, and from representative examples deduce a general conclusion as to how long a certain pavement ought to last under different conditions.

Granite—It has already been stated that the foundation of a pavement affects its durability very much. Granite blocks are generally laid in two ways, viz., on a concrete base with joints filled with tar and gravel, and on a sand cushion with sand joints. The resulting pavements must be considered as being in separate classes. The reason why the same granite wears out more quickly when laid on sand is because the blocks follow any inequalities in the foundation, and the sand in the joints is often washed out and allows more or less water to percolate down to the foundation, causing unequal settlements. All of these actions affect the stability of the blocks and often cause their displacement, thus preventing the traffic from being applied in accordance with the principle previously laid down, i. e., vertically upon the face of the block, and the result is abnormal wear. Probably the best example of a first-class granite pavement is that upon the approaches of the New York and Brooklyn suspension bridge. This was thrown open to traffic in May, 1883, and consequently has been in use about 16½ years. During this time it has been subjected to a severe and continuous traffic. **The roadway is 16 feet wide.** The dimensions of the blocks are 3 to 4 inches wide by 8 to 9 inches deep, and 9 to 14 inches long. These were laid on a concrete base and a 2-inch sand cushion with ¾-inch joints between courses. The joints were partially filled with tar and gravel, which was thoroughly consolidated with a calking iron driven home by a heavy hammer when the joint was refilled as before. This pavement has received practically no repairs up to the present time, and Mr. Martin, engineer of the bridge, estimates its further life of ten years, or twenty-six years in all, for a pavement that probably sustains a heavier tonnage per foot of roadway than any street in this country. An article in the Eclectic Engineering Magazine states that on streets near the docks in Liverpool, where the traffic was 360,000 tons per yard of width per annum, the average wear was .02 of an inch per annum. In Leith, Scotland, the repairs to granite are nil for the first ten years, and from that time to 25 years an average of 4 cents per yard per year. In Brooklyn, Clinton Street was paved with granite on a sand foundation about 23 years ago. This is a residential street and has a moderate, though not a heavy traffic; has received absolutely no repairs, and is in such a condition to-day that from 8 to 10 years' further wear may be expected of it. The authorities of the following foreign cities give as the life of granite pavement—Paris, Liverpool and Edinburgh—30 years each, and Glasgow as high as 50 years. Engineers of the United States do not as a rule assign so long a life, and it is doubtful if our granite is as durable as that used in Europe, so that it is reasonable to suppose that their pavements will last longer despite their greater traffic. It would seem fair, then, to estimate the life of a granite pavement on concrete with tar and gravel joints at 25 years, and on a sand base at 20 years.

Wood—It is extremely difficult to generalize upon the life of a wood pavement. It is laid of so many different varieties of material, in so many different ways as to foundation and joint filling, and with such varied chemical treatment, that a conclusion in one case will hardly have an application in another. For instance, the ordinary cedar block pavement as laid in Chicago and other Western cities requires replacing about every seven years. A similar cypress block pavement laid in Omaha in 1888 was taken up in 1892 and replaced with brick. Nicholson pavement laid in Brooklyn in 1869 had an average life of about 6 years, and in St. Louis of 6 years 3 months. A hemlock pavement laid in Philadelphia as early as 1839 was renewed in four years. Wood wore annually as follows in London: On Sloane Street, .065 of an inch, traffic 279 tons per yard of .. width per day; on Fleet Street, .456 of an inch, traffic 1360 tons per yard per day; on London Bridge, King William Street, the blocks wore 2⅝ inches in three years and two months where the traffic was 1,200 vehicles per yard for twelve hours. Mr. Haywood made the general statement that wooden pavements wore from .2 to .3 of an inch per year under a traffic of from 300 to 660 vehicles per yard for twelve hours. The Place de la Concorde, Paris, was paved with wood in 1885, and relaid in 1895. The average annual wear of nine different streets was .1357 inch, the variation being from .0746 to .2908 inch.

Wood of the eucalyptus family has been used very successfully in Australia. It was first laid in 1880; and in a paper written by Mr. W. A. Smith, M. Inst. C. E., in 1894, many interesting facts are found. The blocks—3 inches wide by 6 inches deep and 9 inches long—were first dipped in tar and laid on concrete. The first pavements were laid with 1-inch joints filled with stone screenings or bituminous matter, but experience demonstrated that better results could be obtained with close joints, except on steep grades. Mr. Smith states that on taking up a portion of pavement laid with ⅜-inch joints filled with Portland cement grout, which had been down six years, dry rot had set in wherever the cement had touched the blocks; while on another street, where the joints had been filled with a mixture of tar and basalt screenings, the wood was found to be perfectly sound, and although it had been in use eight years, it was practically as good as when laid, and the greatest wear observable was 1-16 inch under a daily traffic of 25,000 tons. On another street the blocks had worn 9-16 inch in thirteen years. Mr. Smith estimates that Australian hard-wood will last twenty-one years in a pavement and sustain a daily traffic of 1,200 tons per yard of width.

Mr. George W. Bell, formerly U. S. Consul to Sidney, N. S. W., states that after eleven years several blocks taken from George Street had worn less than ½ inch. The roadway of this street is 48 feet wide, and is subjected to very heavy traffic. Mr. Bell estimates the life of the pavement at twenty years.

In 1895 a pavement was laid of Australian harri karri wood on 20th Street, between Broadway and Fifth Avenue, New York city. The blocks were as above described, and after having their lower half dipped in hot tar, were placed closely together on a concrete base, an open joint 1 inch wide being left at the curb for expansion. This joint was afterwards filled with asphalt. At the present time there are a very few blocks on this street that show signs of decay; but as a whole, where untouched by the plumber, the pavement is in as good condition as when laid.

In European cities the duration of wooden pavement is: Paris, 8 years; Liverpool, 15 to 18 years; Glasgow, 6 years; Edinburgh, redwood 8, and Australian wood 15 years; and London, 5 to 8 years for Baltic deal and 12 years for Australian.

The Tenth Street viaduct in Omaha was paved with sawed cypress blocks in 1890. An inspector was sent South when the blocks were purchased, who carefully examined all lumber before it was sawed, so that none but the best would be used. This pavement lasted nine years.

From the above figures it will be seen how impossible it is to deduce a positive result. But it does seem justifiable to conclude that a wood pavement that requires renewing in this country in less than from 10 to 15 years should never be laid.

Asphalt—This material has now been in general use in this country for about sixteen years. It has been laid under very different conditions, often by inexperienced workmen and on varied foundations, so that sufficient data has not been collected to give conclusive results. Many pavements have failed in attempting to economize by utilizing old material on the street. This has often proved fatal economy, as asphalt depends entirely upon its base, the asphalt itself being only the carpet laid upon the foundation floor beneath. When the floor breaks the carpet must fail.

The following tables have been compiled from statistics from Washington, Buffalo, Cincinnati and Omaha, showing the cost of asphalt repairs under certain conditions in an attempt to ascertain when the economic end of an asphalt pavement comes. Before considering them it should be stated how the repairs were paid for and the tables made up. Washington pays a price in bulk for material used. In 1897 it was, for skimming or heater work, 95 cents per cubic foot; and where the old material is entirely removed, for wearing surface 52 cents and binder 30 cents per cubic foot, measured in the carts. Buffalo pays per square yard for actual work performed, the price in 1897 being for skimming

98 cents and for resurfacing $1.46, while in 1898 it had fallen to $0.64 and $1.05, respectively. Cincinnati paid a lump sum per year for the first and second five years after expiration of guarantee, averaging .07½ cents per yard for the first and 14 cents for the second period over the entire area. The contract for the second period is still in force. When the original guarantee expired in Omaha in 1888, a contract was entered into with the asphalt company to keep all the streets paved at that time in repair for ten years at a cost of 8 cents per yard per year.

Here are four different systems of making repairs. It will be readily seen that in deciding what it will cost to repair a pavement five, or as was the case in Omaha, ten years in the future, at a time, too, when no asphalt pavement had been down fifteen years, any company must make a guess at the cost, and that the guess will be made on the safe side.

Table No. 1 shows the average annual cost per yard for asphalt repairs after the expiration of guarantee at the end of different periods.

Table No. 2 shows the average cost per yard for each year after guarantee has expired. The figures are compiled from the reports of 1897 for Washington and Buffalo, and from personal information from Cincinnati and Omaha.

TABLE NO. 1. (1)

Year out of Guarantee.	Washington.	Buffalo.	Cincinnati.	Omaha.
1	.000417	.0132	.075	.08
2	.00159	.0234	.075	.08
3	....	.0229	.075	.08
4	....	.0391	.075	.08
5	.0071	.0521	.075	.08
6	.0143	.0916	.0858	.08
7	.03616	.0749	.0936	.08
8	.04518	.0502	.0994	.08
9	.04421	.0691	.1039	.08
10	.04815	.0219	.1075	.08
11	.03816	.0200	.....	.0754
12	.02318	.0280	.....	.....
13	.0747	.0415	.....	.....
14	.1223	.....	.....	.....
15	.0773	.....	.....	.....
16	....	.....	.....	.....
17	.0241	.....	.....	.....

TABLE NO. 2 (9).

Year out of Guarantee.	Washington.	Buffalo.	Cincinnati.	Omaha.
1	.0039	.029	.075	.08
2	.0074	.057	.075	.08
3	.045	.051	.075	.08
4	.034	.095	.075	.08
5	.054	.074	.075	.08
6	.057	.084	.140	.08
7	.068	.056	.140	.08
8	.086	.042	.140	.08
9	.072	.027	.140	.08
10	.080	.031	.140	.08
11	.035	.040	....	.03+
12	.031	.040	....	...
13	.033	.106	....	...
14	.026	....	....	...
15	.025	....	....	...
16	.128	....	....	...
17	.031	....	....	...

The guarantee period in everey case is five years, except for the streets paved in Buffalo in 1886, when it was eight years. Applying now the formula presented for ascertaining the economic end of a pavement, it will be seen that Cincinnati has about reached the limit where new pavements are required. As a matter of fact, this 14 cents being an average, several streets have probably passed the point where it is profitable to repair them. Omaha's price being the same for the whole time, gives no information; but with the exception of the 13th year after laying in Buffalo and the 21st in Washington, none of the others seem to be suffering from use or time. It will be noted, however, that about midway in the records of the last two cities are four or five years where the cost appreciably exceeds those immediately before and after them. This probably means that the repairs on some streets were abnormally high during those years. It must be remembered, also, that while these figures represent cost, they do not necessarily indicate the relative amount of work done, as the reduced price per yard in Buffalo for 1898, over 1897, would allow about 40 per cent. more resurfacing to be done without increasing the cost.

No arbitrary life, then, can be assigned to an asphalt pavement. Paris allows it 15 years, Liverpool 12, and Edinburgh from 12 to 15 years.

In Leith, Scotland, one asphalt street averaged 5 cents per yard annually for 15 years succeeding the third year after it was laid.

The author, in the light of figures herein given, would consider that in the United States an asphalt pavement, properly laid and maintained, should last from 15 to 20 years under average conditions.

Since this paper has been written the report of the Board of Public Works of Buffalo for 1898 has been received. This shows the average cost per yard of all asphalt maintained in Buffalo during the last four years to be: 1895, $0.067; 1896, $0.0439; 1897, $0.0480; 1898, $0.0288. These, it must be remembered, are averages. The Engineer in the same report submits a list of 27 streets which he recommends for resurfacing, as they have cost a total of from $0.2234 to $1.20 per yard for the last four years. Only 2¾ per cent. of the entire pavement under maintenance was repaired in 1898, as against 5½ per cent. in 1895.

Brick—As at present laid, brick pavements have not been in use long enough in this country to enable one to make anything more than an estimate of their probable life. The early pavements were laid in small cities, where the travel was light and where the streets were not kept clean. On the other hand, the bricks, as compared to those of the present time, were poor and poorly laid. A brick was too often considered to be a brick, and one as good as another. Many experiments were tried with foundations, sizes, and material for joint filling, and even now these items are not all satisfactorily settled. It is generally considered by engineers that sand is the poorest filler, yet Mr. Cappelen, City Engineer of Minneapolis, states in his report for 1898 that when that city asked for bids for furnishing brick for the city's use with a 15-year guarantee, and allowing the manufacturers to state their preferences for a joint filler, one firm preferred sand for that purpose, and refused to guarantee its brick for more than five years unless sand was used.

Many of the early pavements were very durable. One in Bloomington, Ill., laid in 1875, was renewed in 1894, when the bricks were worn off ¾ inch. Another in Charlestown, W. Va., lasted still longer. Many others, however, failed quickly on account of poor material being used and bad construction. The paving bricks of to-day are very different from those of twenty years ago, and they are laid much more intelligently. In his report for 1897, the City Engineer of Des Moines estimates the life of a brick pavement in that city to be from 12 to 15 years on a business street, and from 25 to 30 years on a residential street. The City Engineer of Peoria, Ill., estimates the life of a brick pavement at 25 years, and the Engineer of Bloomington, Ill., at from 15 to 20 years. The Superintendent of Water-Works at Steubenville, Ohio, writes that the first brick pavement was laid in 1884, is in good repair at the present time, and will last ten years longer without repairs.

In 1895 Nevins Street in Brooklyn was paved 22 feet wide with Metropolitan blocks from Canton, Ohio. The street has a moderately heavy and continuous traffic. During the present summer the brick were measured in the center of the street, and, except in a few cases, there was no perceptible loss. It seems safe to predict for this pavement a life of from 10 to 12 years, despite the traffic. In a residential portion of the city it would surely last 50 per cent. longer.

Philadelphia, where there are probably more miles of brick pavement than in any other city in the world, estimates its life at ten years. The author, however, thinks he is conservative in assigning it a duration of fifteen years when the brick are well vitrified and properly laid.

Macadam—This pavement can be truly said to have no end if properly cared for, but it requires an almost constant infusion of the elixir of repairs to bring about this eternal life. The exact amount depends upon the traffic and character of the stone, varying greatly in different cities. Nashville, Tenn., renews some of her streets twice in one year. One technical journal states that a street in St. Louis has had enough broken stone spread upon it to raise its surface 22 feet. In 1884, in London, macadam on Parliament Street cost $0.70, on Whitehall Street $0.71, and on Victoria Street $0.50 per yard for repairs. Glasgow maintains her macadam streets at an annual cost of 0.12 per yard, while Paris in 1893 paid $0.44 for the same purpose. The author will not attempt to assign a limit for macadam.

In summing up the conclusions arrived at in this paper it must be borne in mind that the results are very general, subject to many modifications, but based upon good material being laid in a proper manner, and each pavement under conditions fairly favorable to its use.

The estimated life then is for

Granite, on concrete, 25 years; on sand, 20 years.
Brick, 15 years.
Wood, 10 to 15 years.
Asphalt, 18 years.

---

(1) Assuming you have a paved street and the repairs are amounting to a great deal every year; and the question comes up, shall you continue these repairs or shall you repave the street?

(2) N. equals the life of the proposed pavement; C. equals the cost; I. equals the rate of interest you have to pay on the bonds; R. equals the estimated cost of repairs if distributed over the entire life; and A. equals the sinking fund to be paid each year to equal C., the cost, at the end of N. years, the total life of the pavement. Then the actual annual cost of the new pavement, after it is laid down, is A. plus C. I. plus R. divided by N. Take, for instance, an asphalt pavement, and let N. (the life) equal 15 years; C. equal $1.50; the rate of interest 3½ cents and the repairs for 15 years 40 cents per yard for the entire time; the annual cost of the new pavement figures 15.99 cents per square yard per annum. That is, after you have the pavement all laid, it is going to cost you

16 cents per square yard per year for the entire life; consequently, if you can repair an asphalt pavement for materially less than 16 cents per square yard you can do it rather than to repave, provided these values that I have used for these different terms are what you could use under your conditions. But if you change this and assume that the life of the pavement is to be twenty years instead of fifteen, then the cost will figure 13.56 cents, or 13½ cents, if you take the life to be twenty years and the other values as I have used them. I have used the cost of $1.50 and the rate of interest 3½ per cent., and the repairs 4 per cent. per year—4 cents after the pavements are guaranteed for the entire twenty years—so that the items are all small; and if you increase them, then you increase the cost of the pavement and make the amount of repairs as I have it more.

(3 In such a case the engineer would have to use his own judgment.

(4) This is in addition to the ordinary traffic on a street running along the river front.

(5) This, you must understand, refers to the asphalt surface only, not to the base; although the price for concreting is always higher on a street car street.

(6) These last figures are perhaps a little against my argument; in fact, it does show the cost of a residence street to be 1 mill in favor of a street with street car tracks; but perhaps that was because the traffic went entirely on the rails. But, however, from one instance only you cannot introduce any rule that is positive.

(7) These foreign figures I obtained personally this present year.

(8) I have here some tables that are made up from the reports (Refers to figures on board) showing the cost of repairs to asphalt in four different cities. They are the only cities I know of where it has been possible to get the information for that length of time. To understand these tables you must know how they are paid. Washington pays so much per cubic yard for the material measured in carts; a certain price if the entire pavement was taken up and a certain price if only the surface. Buffalo pays a certain price per square yard for the actual amount of yards laid when they repair it. Cincinnati has taken lump bids for so much per street for five years; taking it in two periods, five years and the succeeding five years. In Omaha, when the first guaranteed contracts expired, they made a contract with the company to keep all the streets in repair for ten years at the one price of 8 cents per yard per year.

There are four ways of repairing pavements—the first to have some bearing upon the work done; the second two, in Cincinnati and Omaha, must only be guesses by the company, especially in the case of Omaha, where a contract was made in 1888 when there had not been a single street down ten years in the country and the company comes in and makes a contract to keep a street repaired for ten years. They are making a guess, and of course they will guess on their own side—that will be shown on the next table.

I want you to understand these two tables because they are a little difficult to understand; it took me two or three days to get them through my head, This is taken from the 1897 report of Washington and it means that on all the pavements in Washington that had been out of guarantee one year only in 1897 the average cost was 4 and 17-1000 cents per yard; that was only for the streets that had been out of guarantee one year; it had no reference to the other streets. In Buffalo the cost was 1 cent and 82-100 of a cent. In Cincinnati it was 7½ cents, and in Omaha it was 8 cents.

Following that down the same way, the streets that had been out of guarantee in Washington cost 1½ mills; in Buffalo they cost 2 34-100 cents; and in Cincinnati and Omaha there is the same cost as in the one-year column—Cincinnati covered five years, and Omaha ten.

I made those tables up in attempting to find out from them where would be the economical life of a pavement; and you see how impossible it is to do that, because, when you get down here in Buffalo to a pavement that has been down thirteen years the average cost of all those streets was only 4 and 15-100 cents. You must understand that these figures are made up of the averages of different streets, and they may not be exactly correct, because if one street had 15,000 yards in it and another street had 1,500, and the average was a certain sum, this would show the difference between the two, while it might not prove good on the whole streets per yard; but it cannot be very far out of the way when the number of streets is as large as in these tables.

(10) This next table shows all the streets that have been out of guarantee one year, applying to all cities. For instance, this column down here (I think the speaker referred to column headed Washington) enters into all. That "39" covers some repairs done twelve years ago, thirteen years ago, five years ago, one year ago and two years ago; that is to

say, they could tell what every street in the city cost when it had been one year out of guarantee; and the average of all the streets that had been out of guarantee was 89 cents. This table is so much per "year," while the first table shows so much per "yard."

In Omaha it is the same, 8 cents. In Cincinnati the bids for the first five years averaged 7½ cents per yard and for the second five years 14 cents per yard.

In Omaha this price covered down to fifteen years; the first street that they laid in Omaha, or the first street that they laid in the West, in asphalt, was in 1882, and I wrote to the City Engineer asking him how much it cost for one year after the ten years' guarantee expired. He says, We have expended on that $150, we should have expended $500; if we had expended $500 the cost would have been 3 cents per yard for a street that had been down sixteen years, and the price for the ten years—they paid 8 cents per yard.

It does not follow it would cost any less than that before, because at the end of this guarantee they might have compelled the company to put it in such good repair that next year it would not cost anything.

(10) Mr. Drake—It is ten years.

Mr. Tillson—The report gives it eight years.

Mr. Drake—It is ten years now.

Mr. Tillson—I mean for the figures we have here.

(11) Now, there is another thing that cuts a good deal of figure in these repairs, and that is where they are taking, as they do in Buffalo and Washington, bids every year. The price for repairing in Buffalo on the same principle was so much less in 1898 than it was in 1897 that they could do 40 per cent. more work for the same money; so that, you see, figures made up like these are not safe as regards the actual amount of work done, but they do show the expenditure was made; and with about a quarter of a million more yards of pavement that were maintained, they did not require repairing of quite as much; that is, there were not quite as many square yards as the previous year.

THE PRESIDENT: The next paper listed on the program is a paper on "Recent Methods of Testing Paving Brick," but I understand it has not yet arrived. Does the Chairman of the Committee wish to substitute the paper on "Brick Pavements in Various Cities," by Mr. Hastings?

A MEMBER: I ask for that to be left over.

THE PRESIDENT: The next paper by an author who is present is one on "The Physical Properties of Asphalt," by Mr. W. H. Broadhurst, Chemist of the Department of Highways, Brooklyn.

THE PHYSICAL PROPERTIES OF ASPHALTS AND ASPHALTIC CEMENTS.

BY W. H. BROADHDURST, CHEMIST DEPARTMENT OF HIGHWAYS, BROOKLYN.

It is only within the past five years that domestic asphalts have met the imported product in successful competition in our Eastern cities. Vast deposits of natural bitumen have been opened up in California, Utah, Indian Territory and Texas. The output from these States includes malthas, or natural asphalt fluxes, and hard asphalts in various grades of relative purity. A number of these have already proved their suitability for paving purposes, so that, while the Trinidad product was used almost exclusively in the early days of the industry, to-day the expert is called upon to pass judgment on over a dozen relatively pure paving asphalts, and an endless number of rock asphalts, asphaltic cements, and asphalt fluxes, both natural and artificial. It is hardly necessary to add that there are asphaltic cements on the market composed of nearly every available kind of cheap bitumen. As the purpose of the asphaltic cement in a pavement is to bind the particles of sand together—a function purely physical—a consideration of the physical nature of the pure bituminous matter which it contains is of great importance, and should in all cases supplement the chemical examination.

Asphalts vary in proximate composition, according to the character of the geological formation in which they exist. As found in nature, they contain a cementitious substance called bitumen and a certain amount of foreign matter, mainly mineral, which varies in amount in different deposits, from merely a trace in some cases to 90 per cent. and over in others. These latter include the asphaltic sandstones and limestones. This mineral matter, if it be inert and insoluble in water, is of no detriment to the use of an asphalt for paving purposes. It is the non-bituminous organic matter which is prejudicial.

If any of these asphalts be submitted to the action of a solvent, such as chloroform or bisulphid of carbon, and then filtered, it will be found that the bitumen dissolves, leaving the foreign matter on the filter as a residue. After the complete evaporation of the solvent from the filtrate of such solutions, the bituminous substance from each will be left in a state of purity, and a fair comparison of their physical properties is then possible. The physical properties of these pure bitumens, dependent on the molecular forces of cohesion and adhesion, will be found to include the following:

Properties dependent on Cohesion:
  Consistency (Relative hardness or softness).
  Viscosity,
  Tenacity,
  Elasticity,
  Fracture.
Properties dependent on Cohesion and Adhesion:
  Capillarity,
  Ductility.

It will be found that all pure asphalt-bitumens exhibit these properties in a greater or less degree, dependent on the consistency. They are all viscous—that is, they flow, or are capable of flowing. This is the characteristic property of asphalt-bitumen and is perceptible even in the hardest varieties, although the motion is very slow. Maxwell* has pointed out that "When the very smallest stress, if continued long enough, will cause a constantly increasing change of form, the body must be regarded as a viscous fluid." Under this definition viscous bitumens must be regarded as liquids, no matter how hard they may be. Hard bitumens must be regarded, however, not only as liquids, but as liquids which contain a solid in solution. This solid is called "asphaltene," and when present in sufficient quantity, the bitumen shows a characteristic conchoidal fracture—a property of solids. This property of fracture is evident, even in comparatively soft bitumens when struck a sharp blow. For paving purposes it has been found necessary to temper hard asphalts with a flux or softening agent so as to reduce this property of fracture or brittleness, which becomes more marked as the temperature decreases to a minimum and still give an asphaltic cement of sufficient tenacity to produce a surface mixture with a given sand that will not mark readily under traffic on the hottest days of summer. There are two kinds of flux in common use for this purpose—malthas, or natural bituminous fluxes, and petroleum residuums, or artificial bituminous fluxes: the one class composed of soft natural bitumens of high viscous index and of the same nature as the asphalt; the other class composed of liquid paraffins, of little viscosity and which change rapidly, on the reduction of the temperature, to a soft solid of no viscosity. "Pittsburg Flux," made by heating petroleum residuum with sulphur, has also been used to some extent to replace a portion of the petroleum residuum in asphaltic cements. It is a soft solid. These artificial fluxes differ markedly from natural bitumen, not alone in viscosity but also in ductility; they are termed "short," that is, they cannot be drawn out into a long string. Malthas, however, are ductile in a very marked degree, and the same property is more or less manifest in the hard asphalts on the application of heat. This property, together with elasticity in the asphaltic cement, is of primary importance, admitting of expansion and contraction in the pavement without cracking. It is obvious that the flux must impart its properties to the asphaltic cement containing it. To show the comparative ductility of pure asphaltic cements made of pure Trinidad bitumen and petroleum residuum, pure Bermudez bitumen and petroleum residuum, and pure Alcatraz bitumen and California (Alcatraz) maltha respectively, the following experiments were carried out:

---

*Heat—p, 296.

Twenty grammes of pure bitumen were extracted from each of the above-named asphalts with chloroform. The last portion of the solvent was removed by heating the extracted matter in flat-bottom dishes at 212° F. for eight hours, the temperature being raised to 300° F. for ten minutes at the end of the operation. To the pure Trinidad bitumen petroleum residuum was then added to the amount of 33 per cent. of its weight. (This percentage is calculated from the usual proportion of 18 lbs. of residuum to 100 lbs. of refined Trinidad asphalt, containing 55 per cent. bitumen.) The penetration was then taken with the Bowen Penetration Machine, and found to be 40° at 80° F. The pure Bermudez bitumen was brought to the same degree of penetration, requiring approximately 13 per cent. of its weight of petroleum residuum. The pure Alcatraz bitumen required approximately 24 per cent. of Alcatraz Maltha (2-X grade) to give a penetration of 40°. As a matter of technical interest, a separate portion of Trinidad bitumen was brought to 40° penetration with Alcatraz Maltha. These four cements were poured while hot into glass tubes 2½ in. in length and 5-16 in. in internal diameter, closed at one end with a cylindrical cork. These tubes had previously been cut in half, the edges ground true to plane, and cemented together with a thin film of plaster of paris. This cement joint being easily broken by a slight side pressure, we have in each case a uniform cross-section of pure bitumen; and the weight of each tube being the same, a uniform force acting on it. These tubes were kept at a temperature of 80° F. for one hour. They were then clamped in a vertical position and separated a distance of exactly ¼ of an inch. The lower tube was then allowed to draw apart from the upper under its own weight, thus pulling the cement out into a string, the cross-section decreasing as the length increased. The distance between the tubes at the time of rupture was noted, and the following results obtained:

RELATIVE DUCTILITY OF PURE ASPHALTIC CEMENTS.

Sample No.	Composition of Cement.	Penetration at 80° F.	Ductility at 80° F.	Ductility at 90° F.
1.	Pure Trin. Bitumen + residuum...........	40°	½ in.	¾ in.
2.	Pure Bermudez Bitumen + residuum......	40°	1½ in.	2½ in.
3.	Pure Alcatraz Bitumen + Alcatraz maltha	40°	2¼ in.	4½ in.
4.	Pure Trin. Bitumen + Alcatraz maltha....	40°	2⅛ in.	4¼ in.
	(ADDITIONAL TESTS.)			
5.	A Commercial Paving Matrix, 99% Bit....	40°	⅜ in.	...
6.	Soft Alcatraz Asphalt (pure bitumen)......	50°	4½ in.	...
7.	Uvalda Asphalt + Alcatraz Maltha........	50°	5½ in.	...

The rate at which the tubes separate in these tests may be taken as a measure of the tenacity. Capillarity and elasticity are also shown in a very marked way. Elasticity was most noticeable in sample No. 7, containing Uvalde asphalt. This sample also showed the greatest ductility. Other cross-sections and standards of consistency may be used, but each test being conducted under exactly similar conditions, the results will be comparable.

In regard to the use of fluxes, there remains another side of the question to be considered. Richardson* has shown that these malthas lose a much larger percentage of matter volatile at temperatures of 325° F. and 400° F. than residuums, the effect being to harden the maltha. This test for "matter volatile," however, should be conducted not alone on the maltha but also on the asphaltic cement. In the latter case, the more stable oils (volatile between 250° F. and 400° F.) volatilize with difficulty, being mixed with and protected by a large bulk of hard bitumen. The writer has found that good California malthas do not volatilize more than the following percentages of light oils if heated at the following temperatures in bulk to the amount of 50 grammes in an open evaporating dish:

Matter volatile at 250° F. in 8 hrs., not over......	.55%
Matter volatile at 325° F. in 8 hrs., not over......	4.50%
Matter volatile at 400° F. in 8 hrs., not over......	7.50%

If the percentage of volatile oils in a fux runs appreciably over these figures, it should be further refined or entirely rejected. After the cement is once in the pavement, hardening due to ageing is no more rapid in cements containing good malthas than in those made with residuum; and further, we know that the hardening of malthas in nature is a very slow process.

THE PRESIDENT: We next have on the schedule a paper by the Honorable James S. Fullerton, Queen's Counsel, Toronto, on "Damages from Non-Repair of Highways."

MR. FULLERTON: Mr. Chairman and Gentlemen, the two instructive papers we have listened to are to teach us how to keep our highways in repair; the paper I am about to read to you is to tell you what will happen to you if you do not keep them in repair. They may be called the "Sermon," and mine perhaps will be the "Application." The statute I propose to deal with is Section 606, Sub-Section 1, of the Revised Statute of Ontario, 1897, Chapter 222.

DAMAGES FOR NON-REPAIR OF HIGHWAYS.

BY HON. JAMES S. FULLERTON, QUEEN'S COUNSEL, TORONTO, CAN.

Section 606, Sub-Section 1, of the Revised Statutes of Ontario, 1897, Chapter 223, provides that "Every public road, street, bridge and high-

---

*Municipal Eng.—July, 1897.

"way shall be kept in repair by the Corporation, and on default of the "Corporation so to keep in repair, the Corporation, besides being subject to any punishment provided by law, shall be civilly responsible "for all damages sustained by any person by reason of such default, "but the action must be brought within three months after the damages "have been sustained."

It will be observed that the statute divides itself into two parts—

First: Imposing the duty to keep in repair;

Second: Imposing responsibility for damages sustained by any person by reason of default.

This section in practically its present form is to be found in the Consolidated Statutes of Upper Canada in 1859, and is believed to have been modeled upon an earlier New England statute; and statutes of similar import are to be found in many, if not all, the States of the American Union. The provision, therefore, is by no means new; and as it has probably been the basis of ten times as many actions at law as any other clause in the Revised Statutes, it can scarcely be said to be "untried."

Whether this provision was new law, or was merely declaratory of the Common Law, was for some time a debatable and debated question, and dicta and decisions are to be found pointing both ways. But that question was set at rest by the judgment in Pictou vs. Geldert, 1893, Appeal Cases, at p. 524.

The Province of Nova Scotia has not, or had not in the early '90's, a statute similar to ours, but the duty of maintaining highways had been imposed upon the municipalities by "The County Incorporations Act of 1879." One Geldert met with a mishap which he attributed to non-repair of a highway, and sued the municipality of Pictou therefor, and obtained at the trial and maintained in the courts of Nova Scotia a verdict awarding him damages with judgment accordingly. The municipality appealed to the Privy Council, which (perhaps superfluous to remark) is the highest court to which colonial cases can be carried, and in giving judgment Lord Hobhouse says, "By the Common Law of "England, which is also that of Nova Scotia, public bodies charged "with the duty of keeping public roads and bridges in repair, and liable "to an indictment for a breach of this duty, were nevertheless not liable "to an action for damages at the suit of a person who had suffered "injury from this failure to keep the roads and bridges in proper "repair * * * *. It must now be taken as settled law that a transfer "to a public Corporation of the obligation to repair does not of itself "render such Corporation liable to an action in respect of mere non-"feasance. In order to establish such liability it must be shown that "the Legislature has used language indicating an intention that this "liability SHALL BE IMPOSED."

The statute therefore, has effected a great change in the liability of municipalities. Before the statute was passed they were only liable in damages for misfeasance. That is for misdeed or the improper or negligent performance of the imposed duty.

After the statute they remained liable for their misfeasance, and became liable for the ravages of time—for natural decay, for destruction or change by the elements, or otherwise, and for the misdeeds and negligence of others, all of which they were bound to remedy—at least upon notice at their peril.

Besides the very large increase in liability thus created, the courts in this Province have given a very liberal interpretation to the words "keep in repair," and the American courts have perhaps gone somewhat further than our own in interpreting similar words, but certainly ours are a close second.

The first idea that would strike one's mind is that "repair" would only apply to some structural defect or condition in the "road, street, bridge or highway," according to the plan of construction. But such has not been the result of judicial decision. Let me give a few instances. A crooked stick that had fallen from a passing load of cordwood—a telegraph pole left on the side of the road for the purpose of being subsequently erected—the overhanging branch of a trree—a crooked or leaning trolley pole. These and other similar cases where contact therewith has resulted in injury have been held a "want of repair." So, where a horse frightened at a new plank laid in a bridge backed off the bridge and over the embankment thereof, the absence of a guard rail on the embankment was held a "want of repair." Similarly, the owner of a runaway team that left the highway and plunged down the side of a hill was held entitled to damages for want of such a guard rail. There are many guard rail cases. I have often thought that the logical sequence of the guard rail cases would be that every roadside ditch deep enough to upset a vehicle should have a guard rail. Horses have some horse sense, and are far more likely to shy into a three-foot ditch than to spring down a twelve-foot embankment, and the results to the driver and overturned vehicle may be equally disastrous.

But another class of cases has gone even farther than these. Thus, a pile of tile left in proximity to the traveled part of a highway for the purpose of repairing a culvert—a trip hammer similarly left—a pile of lumber on the roadside—a house left overnight while being moved along a highway, and a thousand other similar and dissimilar things which have frightened restless or ill-trained animals, and caused them to do damage, have been adjudged a "negleft to keep in repair," and damages assessed accordingly (2).

But all such cases have not been uniformly successful. In the case of the house being moved, above referred to, a higher court reversed the decision of the Trial Judge on the ground that there had not been sufficient notice to the Corporation. In Rounds vs. Stratford the owner of a wagon left it upon the roadside with a board used for a seat standing on end therein. This board, it was alleged, frightened a passing team. The courts held it was not a "want of repair" in the highway. In a recent case an estimable Judge held at the trial that the necessary condition of a highway upon which a street railway was being constructed, and over which two women chose to pass in broad daylight with full knowledge of the condition of the highway, was such a want of repair that one of the women who fell in a crossing could recover damages for injuries sustained; but on appeal a higher court refused to sanction the doctrine that work of construction or repair could in itself be held a "failure to keep in repair," and reversed the decision.

Perhaps the most prolific cause of claims for damages—not excepting even the broken plank in the sidewalk—is slipperiness from ice and snow or as plaintiff's witnesses are wont to say, from "accumulations of ice and snow." "The wind bloweth where it listeth, and thou hearest the sound thereof, but canst not tell whence it cometh or whither it goeth." But this we can tell, that in this climate, in its season it brings with it the sleet and the snow. A storm of rain sets in at night, freezing as it falls, and in the morning asphalt pavement, and granolithic sidewalk, and even wooden walks are as a sheet of pane glass The storm turns to snow, and sifts down an inch or a foot. The wind drifts it to and fro, the passing feet of men and horses and the runners of sleighs pound it up or pack it together. It is shoveled and swept from sidewalk and crossing. In places the sun beats down upon it and thaws it away, and the melted snow runs and again freezes An army of men could not prevent it from becoming "accumulated," uneven or dangerously slippery in places. A passerby slips, falls and is injured. Three months later he sues for damages. The snow is gone, and with it the slipperiness. He and his witnesses have marked this spot. It was, they swear, a nasty, slippery, dangerous place—came down with a sharp incline—three or four inches of a ridge—several people slipped there—dangerous for several days before, and so on.

The result is probably a verdict with large damages, while the probabilities are that the place was no worse than a thousand others; that no reasonable amount of care could have prevented.

This crop of litigation is an annual that depends for its yield rather on the extent and rapidity of the weather changes than on the care of the Street Commissioner.

In 1894 the Legislature added a sub-section to the above-quoted section, requiring in cities, towns and villages that notice shall be given of the accident and the cause thereto within seven days and in townships within thirty days after the happening thereof. The result has been that in Toronto at least this class of action has largely disappeared. In looking over the docket for the winter of 1898-9, I find that only one action has been entered arising from this cause. I remember, before this statute was passed, when fifteen and sixteen actions against the city for similar cases were not unusual at one Assize. The change therefore, is significant, more particularly so as we have the same Street Commissioner, and although, like some other good things, he may have improved with age, he was recognized as a first-class man when first appointed.

The whole reason being that the timely notice enables the Corporation to show what was the condition of the place where the accident occurred at the time thereof.

The bicycle has added a new terror to the municipal road builder. The rut through which an ordinary vehicle may pass in safety may easily bring the scorcher to grief. The rights of the public have been judicially defined to be "to pass and repass on foot and with horses and carriages at their free will and pleasure over the highway. Every obstruction which, to a substantial degree, renders the exercise of that right unsafe or inconvenient, is a violation of that right." The bicycle is now a recognized vehicle, and is it not the right of the public to pass and repass on foot and with horse and carriages and on bicycles at their free will and pleasure over the highway? And is not an obstruction which to a substantial degree renders bicycling unsafe or inconvenient a violation of the bicyclist's rights? In large cities the bicycle, as a means of carrying passengers, is to-day more used and for that purpose more important than the carriage. The road rights of the cyclist have already obtained recognition both in State and municipal legislation, and his claims for damages have reached the courts, and we will hear much more of him in the near future, for he has undoubtedly come to stay.

But there is still another class of cases that is an important factor in claims for damages. Let me again illustrate by instances: Some years ago a wrestling bout—quite impromptu—took place in a cellar between two residents of the city of Toronto. One of them was thrown and his leg broken. His companions, after consultation, carried him carefully and deposited him near a broken plank in the sidewalk, where he was soon after discovered by parties who knew nothing of the means by which he got there. His claims and evidence were apparently complete, the damages demanded moderate, and the city settled without even a struggle.

A woman sued the city a few years ago, alleging she slipped into a small hole in the sidewalk, close to the fence of her own yard, was thereby thrown and broke her wrist. The claim was doubted, but she swore to it, could not be contradicted, and got her damages. A woman who was in the house at the time, and who was not called as a witness, has since been malicious enough to say that the plaintiff received the injuries in an altercation with her half-grown-up son, who shoved her off the stairs. In such a case one suspects that the distribution of the spoils has led to trouble, but the truth is not always easy to get at, and this case went no further.

Not long ago another woman sued the city for damages for a fall alleged to have been occasioned by a broken sidewalk. I visited the spot, and found a small piece had been broken out of a plank opposite a vacant lot on the side of the walk furthest from the road, probably done by a crossing cart. The ground was only about two inches below the break, but a human foot might go into the break and receive damage. There was some "want of repair," and the break was old. The woman had been found in the early evening in March on the road, injured, with a companion endeavoring to assist her, and had been carried into an adjoining store, attended to by two doctors, and thence taken to the hospital. The doctors certified to her condition and sobriety, but found her quite hysterical. Under those circumstances I directed her to be examined under oath, and she fearlessly deposed to everything that was necessary to maintain the claim. On reading her examination I noticed that she left the place she worked at 5 p. m. with the woman who was with her at the time of the accident, and that the accident occurred at 7:30, and in this 2½ hours they had only traveled a trifle over half a mile. I then directed that the woman who had accompanied the plaintiff should be interviewed, and her story taken for comparison.

The question of spoils had fortunately come up between these two ladies the day before, and had not been satisfactorily settled, and the companion was willing to tell. According to her story they started at 5 o'clock with a bottle of whiskey to the good, and first strolled down into an adjoining park to have a quiet drink. The weather was cold and the whiskey was warming, and they consumed it all before they left the park. They then made a struggle to carry it, and with some success, until they reached a point 100 feet beyond where the plank was broken. There the plaintiff lurched into the road, fell and broke her leg. While in the hospital the companion searched out the broken plank, and then the full story was concocted. A day or two after this the solicitor for the plaintiff—a very respectable man—got a hint of the true facts, made inquiry, satisfied himself, and immediately withdrew the action (3).

I need not multiply instances (4). The fact is that frauds upon corporations by reason of this statute are easy of perpetration, and are as frequent as upon insurance companies, and many cases that are not wholly fraudulent only succeed because the evidence grossly exaggerates the facts.

I come now to the serious question which prompted me to write this paper.

Have we gained by making municipal corporations civilly liable in damages for neglect to "keep the roads, streets, bridges and highways" in repair? The law is not so in Great Britain and in most of her Colonies. I have yet to learn that the roads there are any the worse on that account. We have gained in litigation; we have gained in trouble. We are pestered with a large number of claims—frivolous and otherwise; but, have the real interests of the community of the citizens generally been advanced by this legislation? Is not the true rule that laid down by the Lord Chancellor of England in the appeal of the Municipal Council of Sydney vs. Boerke (a case from New South Wales), where he says:

"There is no doubt, in a certain sense, a duty incumbent on the Council to see to the maintenance of highways. It is for them to exer-"cise the powers conferred on them by law for the benefit of the com-"munity. In these matters they represent the citizens and ought to "have regard to their interests. For their discharge of these duties they "are responsible to those whom they represent. The members of the "Council are the choice of the citizens, and if they do not use their "powers well they can be displaced. But if they fail to maintain in good "repair the highways of the city, it is not a matter * * * * which "can be the foundation of an action if any citizen should be thereby "aggrieved."

We elect Municipal Councillors to represent us. They know the amount the municipality can afford to spend upon the construction of highways, and in keeping them in repair, and we know how well they do this work. If our Councilmen spend too much or too little, we vote them out.

The roads are and always have been, or ought to have been, the subject of their constant, unremitting care and attention, and will be so whether the action for damages for non-repair remains or is taken away.

Is it fair that the Provincial or State Legislature should impose this liability? Should say to the people of the municipality, "We will permit at Jury or even a Judge to decide whether the duty of keeping in repair the highways has been done by you as it should be done; and if they consider you have failed, you shall be made to pay damages." Has not the result been practically to make the municipalities insurers against road accidents, and frequently against an unjust class of road accidents? The carelessness of the person to whom the accident happens is seldom seen. The only witnesses to it are himself or his friends, who are the witnesses in the action.

Take the case of the over-hanging limb of a tree. Two loads of hay came along, the drivers looked at the limb under which doubtless many loads of hay had previously passed, came to the conclusion they could pass under in safety, and one did so. The second, not satisfied with the room he had, raised his feet against the limb to lift it higher. He failed, and it crushed him (5). Could any Council, by the exercise of reasonable foresight, have anticipated this concurrence of circumstances? If not, should the municipality pay damages?

Then comes the grave question: Should not the statute be either absolutely abolished so far as it imposes civil responsibility, or at least be so modified and safeguarded as would prevent it from being used in the manner it now is? And that question I leave with you.

JAMES S. FULLERTON.

(1) The struggle in the case was whether the imposing of the duty to keep in repair imposed a liability to individuals.

(2) I once spent three days before a Judge and Jury trying to determine whether an Irishman's shanty, built outside of the fence, in his fence corner, was a want of repair of the highway or not; but it ultimately turned out that the horse had shied and gone off the road, as the Judge found, one hundred yards before reaching the shanty, and therefore the shanty was not the cause of the injury.

(3) I may say he showed me his papers and the lady who had told me the facts had told him just an opposite story, and had signed it.

(4) I could tell of several more; I have one case in mind where the plaintiff took her witnesses to four different pieces of ice, on each of which they were to swear that the plaintiff fell—for the purposes of the action. The plaintiff in this case first swore that she went to purchase biscuits; but I found on cross-examination that she went out with an empty bottle to fill it. The plaintiff in this case also withdrew the action.

(5) He had not his horses under control, or he would have stopped them.

The President here retired, and the First Vice-President, Mr. A. D. Thompson of Peoria, Ill., took the chair.

VICE-PRESIDENT THOMPSON: I would like to call the attention of the members to the fact that the agent of the Trunk Line Associations will be here to-morrow, and the certificates for return fare should be turned in to the Secretary immediately after this meeting.

This closes the papers bearing on the question of street paving. The Chairman of the Committee, Mr. Fisher, has a communication from Mr. Miller which he desires to present, and the papers will be open for discussion.

Mr. FISHER read a letter from Mr. J. H. Miller of Newcastle, Pa., and also one from Col. M. A. Downing of Indianapolis. Accompanying the latter was a paper on Creosoted Wood Pavements.

VICE-PRESIDENT THOMPSON: We will hear the paper from Mr. Downing, if Mr. Tillson will read it.

MR. TILLSON here read paper on "Creosoted Wood Block Pavements in Indianapolis," by Mr. M. A. Downing, President Board of Public Works, as follows:

CREOSOTED WOOD BLOCK PAVEMENTS IN INDIANAPOLIS

BY M. A. DOWNING, PRESIDENT BOARD OF PUBLIC WORKS, INDIANAPOLIS, IND.

I have been asked by the President of the Society to give the experience of this city with creosoted wooden block pavements. I have contributed one or two papers on this subject in former years, and would not think of accepting now but for the fact that I receive letters and inquiries from various sources almost daily, making similar inquiries.

When I became a member of the Board of Public Works, a number of years ago, we often had property owners say, "Why can't we have such wood pavements as we see in Paris, London, and other European cities. They seem to be so much cleaner and quieter than asphalt or stone." They insisted that there was a fine dust, a glare, a noise and heat that were positive discomforts, which they could escape to a great extent if they could have a wood pavement; and if we could give them a durable wood pavement they wanted it, and many wanted the wood without conditions, and many petitions for it were presented.

A careful study of wood pavements in this country and Europe followed. There can be no doubt that the consensus of opinion in this country is that the wood block pavement, as commonly known, has not been a success. It seems strange that the glaring defects—one might almost say the kindergarten defects—of those pavements had not been noted and eliminated; but they were not, and millions of square yards of wooden block pavement have been laid and are yet being laid, the only foundation for which is plank laid on sand. The blocks were cut from round, green cedar posts, with the sapwood left on, and in some instances the bark. These blocks, without further preparation, were laid on boards, some gravel tamped into the joints, and covered with coal tar. It would seem almost absurd to call such a structure a pavement. In saying this, I am not forgetting the Nichelson pavement, the principal defect of which was the lack of suitable wood. It seems to me that all the ingenuity and inventive genius of that time were exercised along the line of discovering some odd or novel way to cut and lay the blocks, or to bind and lock them together. As far as I have been able to discover, these things were of little avail. The cardinal defects were:

First: Failure to select wood with sufficient strength and toughness to withstand the loads and abrasion; and

Second: The total absence of any attempts to create conditions to prevent the rotting of the blocks.

Just why it was considered necessary to select white pine and cedar, when the country abounded in the harder and stronger woods, it would be difficult to conjecture; but the fact remains.

And why no adequate effort was made to properly season and treat the wood I leave to engineers to answer. It may have been because it was a new field, and explorers are scarce. Certain it is that if any architect had attempted to build a house of such material, treated in the same way, he would have been severely criticised by his professional brethren, to say the least.

As a result of our studies of wood pavements, we decided to require the concrete foundation in every instance. We first laid Washington red cedar, rectangular blocks without treatment of any kind. This wood was very soft and porous. It was practically the Nichelson pavement. The blocks were laid close together on a one-inch cushion of sand over the concrete. Two heavy traffic resident streets were laid in this way, and they are now in their fifth year. Both are considerably worn on account of the softness of the blocks, while here and there rotted blocks are visible. Washington red cedar was still in the specifications when I became a member of the Board of Public Works. A provision was insterted providing for creosoting, but the specifications were indefinite. The following spring and summer, 1896, four streets were paved with creosoted (about 3 lbs. of oil to the cubic foot of wood) Washington red cedar. These blocks were 4 inches wide and 5 inches with the grain of the wood. The blocks were laid in rows at an angle of 45° with the curb. All of these pavements are in excellent condition at this time, and on parts of them the traffic is heavy. No provision was made for expansion, the blocks were driven as close together as could be with a sledge, and the joints filled as far as could be with paving pitch. We have had some trouble, caused by the blocks bulging. Most of this was on streets where the blocks were not creosoted, but we have had a few cases where the blocks bulged on the streets last mentioned, but nothing serious. The specifications were then changed, providing for the heartwood of the long-leaf Southern yellow pine, with the blocks 4 inches wide, 4 inches deep with the grain of the wood, and impregnated with ten pounds of the best quality of creosote oil. These blocks were laid in the manner above described, except that a space of from 1 to 2 inches (according to width of the street) was left between the curb and the blocks for expansion. This space was filled with dry sand and covered over with heated paving pitch. The interstices were partly filled with fine dry sand, and the street surface rolled to a smooth surface before covering with heated paving pitch and top dressing with fine gravel or screenings. In no instance have we had any trouble on any of these streets from the blocks bulging. The surface of these streets is as smooth as a floor and has a soft brown color that is restful to the eye. Under the heaviest traffic no wear is as yet noticeable, and the streets are in perfect condition. The oldest is about three years old. It appears that the dirt on these pavements does not grind into such fine dust as it does on the asphalt, and consequently is not so unsanitary nor annoying. The cost of cleaning is less than brick or asphalt, for the reason that we do not have to clean as often. We often hear complaints of the heat that comes from the asphalt on hot days. This does not seem to be common to the wood; but the one quality that seems to be pre-eminent is "noiselessness." I think that people pay more attention to this quality of late years than they used to—in fact, they now often demand it; whereas, when I was a younger man, people would speak of it as desirable, but were not willing to be assessed anything extra on that account. We feel that the creosoted wood block pavement is a succcess from every point of view. We believe that, constructed of the material we are using (or other strong woods like beech, tamarack, red or yellow fir), properly creosoted, using first-class quality of creosote without adulteration, that the pavement is more durable than asphalt and brick, and nearly as durable as granite.

It certainly has met with an enthusiastic reception in this city, as is testified to by the great demand for it. We have contracted for about three times as much of it this year as we have for asphalt. There is practically no demand for stone or brick in this city, except for alleys.

We have not adopted the European method of spacing the blocks from a quarter to half an inch apart and filling them with Portland cement grout, but I am not sure that their practice is not preferable. We have found up to this time that our present practice is good, and our Engineer hesitates to depart from it; although I must say that when the blocks are driven so close together it is next to impossible to get any filler in the joints. This may cause swelling later, although I hardly think so.

We have thus far not followed the common European practice of making the surface of the concrete perfectly smooth and laying the blocks directly thereon, but have introduced the one-inch cushion of sand. But if we are called upon to pave heavily trafficked streets we will probably do so, as experience in both London and Paris has shown that the practice has been successful. The Rue de Rivoli in Paris, over which pass 42,000 vehicles per day, and King William Street, the heaviest in London, are both paved with wood in that way. Few people understand the efficacy of creosoting: why the wood seems harder, tougher and more durable. It is simple: Wood dried to 10 per cent. moisture has about double the power to resist crushing and abrasion that it has if very wet. In creosoting, the sap and moisture are removed, and the heavy oil (creosote), which repels moisture, becomes incisted in the fibre of wood. When snow and rain lie on the pavement, they may to some extent get into the cells, but not to any great extent into the fibre, because they cannot displace the oil; hence the fibre remains dry, and of course retains its strength. The uncreosoted wood pavements wear doubly as much in wet weather as they do in dry weather. This is not true of the creosoted wood pavements, for the reason above given.

I might add a word in regard to cost. This would probably vary according to the distance the blocks would have to be freighted. The pavement laid with long-leaf yellow pine blocks, 4 inches deep, treated with ten pounds of the best quaity of creosote oil per cubic foot of wood, laid on a concrete foundation complete, and guaranteed for from five to nine years, has cost us from $2.10 to $2.50 per square yard.

M. A. DOWNING.

VICE-PRESIDENT THOMPSON: The paper by Mr. Hastings will also be read by Mr. Fisher so as to hasten the program.

MR. FISHER read paper by Mr. L. M. Hastings, City Engineer, Cambridge, Mass., on "Brick Pavements in Various Cities, as Viewed by an Ovserver in Search of Information Relating to the Subject," as follows:

BRICK PAVING IN VARIOUS CITIES AS VIEWED BY AN OBSERVER IN SEARCH OF INFORMATION.

BY L. M. HASTINGS, CITY ENGINEER, CAMBRIDGE, MASS.

In most of the cities of the East brick paving is but little known. The nearness to good granite quarries from which to obtain granite block paving of a superior quality, also the abundance of hard ledges from which to obtain cracked stone, has led to the general practice of paving business streets carrying heavy traffic with granite blocks; streets with lighter traffic with asphalt, and by far the larger part of residence and suburban streets with macadam of varying degrees of thickness and merit. The construction of macadam pavements has here reached a high degree of efficiency. I doubt if anywhere in this country can such fine macadam roads be found as may be seen in many of the parks and suburban localities of the Eastern, New England and Middle States. Material and skill have both been plentiful to produce this result. There has long been a desire, however, in more thickly settled communities for a pavement which, while having in a good degree at least the qualities of durability undoubtedly possessed by granite, should yet be superior to it in smoothness, noiselessness and ease of traction. Many object to asphalt on account of its cost, slipperiness and doubtful lasting qualities.

Vitrified paving brick was suggested as a paving material, having in a good degree many of the qualities desired; and so a committee of the city government was authorized to make a tour of inspection to some of the cities where brick pavements had been used for a number of years, to ascertain if their experience would warrant the trial by the city of Cambridge of brick as a paving material on certain streets of the city. Springfield, Mass.; Albany, Rochester, Buffalo and Tonawanda, N. Y.; Cleveland and Canton, O., were visited and also several of the large brick-making plants in New York and Ohio.

Many conflicting reports were received of the results of time and wear on the brick pavement in use, some stating that the brick pavement after a few years' use was failing utterly, crumbling and going to pieces, others stating that it seemed to wear as well as granite—the inevitable Eastern standard of durability.

A somewhat careful examination and inquiry of the brick pavements in the cities visited did not reveal a condition such as the first statement would lead one to expect. The oldest bricks seen were said to be about ten years in service, and were made in small sizes of apparently common building clay. These, while badly chipped and having some soft or underburned brick, still seemed good for several years' wear. One small patch was in really bad shape. In general it may be said that the evidences of durability in good selected brick were better than we had been led to expect.

Inquiry and correspondence revealed at the outset another fact, that, young as the industry is, a most surprising number of factories are now equipped for and are manufacturing paving brick; also that a most intelligent and careful study and comparison of facts relating to the proper materials, their combination and manipulation during the course of manufacture, and a scientific study and comparison of results obtained by laboratory experiments, as well as practical use on streets, had been given to the matter.

The work of Mr. Purington of Chicago, Professor Orten of Columbus, Ohio, Professor Marsten of Iowa, Professor Johnson of St. Louis and others has been of the greatest service, while the patience and skill of the numerous manufacturers and inventors of brick-making machines have largely contributed toward bringing the process of making a satisfactory paving brick to a success.

Large, as the number of manufacturers is, scattered widely and using various materials, it is not surprising that their product shows a marked variation in many important particulars. I should roughly class paving brick, as now made, by the materials used, into shale brick, fire clay brick, and mixed shale and fire clay brick. Samples of all these kinds were seen in service in the cities visited. Special merits are claimed for each of the materials used. It seemed to me that each had some points of superiority, and each might be adapted for certain situations by these qualities. Thus, the shale and largely the mixed shale and fire clay bricks seemed hard, dense and heavy, with a tendency toward brittleness. These bricks seemed adapted for streets with heavy traffic if laid on a heavy concrete base, with joints thoroughly filled with cement to reinforce the edges and corners and to prevent the chipping so noticeable in many pavements. The fire clay bricks, on the other hand, are lighter, softer, more porous, with apparently less tendency to chip and crack, but much more subject to wear by grinding of wheels, hoofs, etc. These brick seem excellently well adapted for a residential street or one carrying a light local traffic. The soft, pleasing colors obtained in these brick must prove an attraction to residents on a street paved with them. This was particularly noticed on some streets in Tonawanda, N. Y., and in several cities seen in passing through Pennsylvania. It would seem, too, that this brick, being softer, would be less noisy than the harder shale brick. Just how far the two materials may be combined with any advantage is one of the nice points which is very difficult to determine.

Several specimens of streets paved with the brick made of mixed materials were seen, which seemed to be standing well. It is claimed by the manufacturers that the introduction of a part of fire clay makes the burning of the brick easier, as the mixed material will bear a higher degree of heat than the bricks made of shale and clay.

At the factories visited the principal operations in the process of brick-making were quite simple, although the details, on which the success of nearly all operations depended, required much thought and care. The materials—shale and clay—were dug from the bank and mixed in the required proportion either at the bank or at the mill; it was then firmly ground, moistened to a proper degree, and put through the brick-making machine. The clay is pressed from the machine through a die of the size of the brick in a continuous stream, and cut by wires into blocks such as will make the required size when dried and burned.

The best size for the brick is a subject about which much diversity of opinion still exists. In general, three sizes are now in use—a small brick size, a larger size or "paver," and the largest size or "block." The two last are the sizes most commonly used, and as to which is the best there seems no general agreement.

As the bricks leave the machine they are rectangular in shape with the sides or ends somewhat rough by having been cut by the wires, and the corners rather sharp.

If desired, the brick are now put into a machine and "repressed" by which the corners and edges are rounded and a more perfect shape and appearance given to the brick.

Much discussion has been had over this operation as to whether the repressing is a benefit or as some still claim a positive injury to the brick. Both "wire cut" and "repressed" pavers were seen in the pavements examined, but no conclusions could be drawn from that, as no difference could be noted in the results of wear, etc. The repressed brick make a smoother and better looking pavement at only a trifling increased cost.

A very important element in the manufacture of a paving brick is a proper burning or degree of vitrification. Properly speaking, a thoroughly vitrified brick would be totally unfit for use as a paver, being glassy and brittle in texture and misshapen in form. It is never attempted to more than partly vitrify a brick, melting the more fusible elements or "fluxes" which form a small percentage of the material, and so uniting the more stable elements, silica and alumina, which form the great bulk of the clay, into a hard, durable, homogeneous mass. It is one of the nice operations of the manufacture to give a kiln containing say 100,000 paving brick just the right degree of heat for from 8 to 10 days so that the larger part of the brick shall be burned or vitrified to just the right degree. For it is a fact that the limit or range of burning within which the best results are obtained is quite small.

The very interesting experiments of Prof. A. Marston, of the Iowa State University, made in 1898, demonstrate this very clearly. One thousand brick each were given by two well known brick manufacturers in the West, for the purpose of experiment and test. These brick were sorted into six different grades according to the amount of burning and consequent hardness. In nearly all the tests given, the brick which had had just the right amount of burning, marked No. 1, stood higher than those which were burned less or more. The necessity for care in burning and in properly selecting the brick to be used for paving was also seen by the results observed on pavements, the brick for which had not been carefully culled.

The lighter colored softer brick, noted in some of the older pavements seen, showed the effects of wear much more than those of a darker harder character. It is highly desirable that the bricks should all be of one uniform degree of hardness. This can only be accomplished by the most careful burning, and a thorough selection or culling out of inferior brick before laying.

The character of the material used in filling the joints between the brick must have an important influence on the success and durability of a brick pavement. Various materials have been used, sand, paving pitch of coal tar or asphalt, a cement made of ground slag and cement, called "Murphy grout," and Portland cement.

Sand, while at first making a good filler, being inexpensive and reducing the liability of the pavements being noisy, soon washes out and leaves the edges of the brick unsupported and so much more liable to become chipped. Pitch, unless made very hard, tends to soften too much in hot weather and run towards the low places in the pavement, as the gutters, leaving the higher parts unprotected.

The Murphy grout works well in places, being fairly hard and elastic, but is said to be uneven in its results, the filling of this material in places being absolutely worthless.

The best results on the whole seem to be obtained by using a high grade of well seasoned Portland cement containing the smallest amount of free lime in its composition; the presence of the lime increasing the tendency for the filler to swell with age and the absorption of moisture, causing the pavement to rise and lift away from the foundation, and so producing the disagreeable roaring or rumbling noise occasionally heard in an otherwise unobjectionable pavement.

It is now thought that this tendency to lift is remedied by introducing at intervals of 25 to 30 feet across the street, and on both sides of the street at the curb, an expansion joint of pitch, so that any movement of the pavement due to swelling of the filler, or to change in temperature, will be taken up by the elasticity of the pitch joints.

Variors types of foundations were noted as being tried in the various cities visited. The best and most satisfactory kind for heavy traffic and poor natural conditions being a layer of 6 inches of American cement concrete placed on the surface of the street after being graded to subgrade and thoroughly compacted by a steam roller. On this was placed a sand cushion 1 inch or 2 inches thick, and on this the brick were laid. Cracked stone was said to have been used in some places, but with not very satisfactory results; the sand cushion having a tendency to wash into the voids in the stone.

It has seemed to me that if the cracked stone were used without screening and a layer of sand or fine gravel spread on the stone, then wet thoroughly and rolled, that a very satisfactory and economical foundation would be made.

In some cities where clayey soil is encountered it is considered necessary to provide under drainage for the foundation, the common method being to place a sub-soil drain under the curb stone at each side of the roadway and about three feet below the surface.

The trench is filled with small stones and the curb set in that as a foundation.

In the preceding remarks little or no attempt has been made to enter into a discussion of the fine and mooted points of the subject; the best materials to be used in the manufacture—the best size to be adopted—whether the bricks are better "side cut" or "end cut"—whether repressing is an advantage or an injury—the proper point at which vitrification or burning should cease—the kind of kiln in which the best results are obtained, etc. These have been exhaustively treated by experts familiar with the theory and best practice of the subject. Prof. Edward Orten gives much valuable information about clays and the brick making industries of Ohio in volume VII, part I, of the Geological survey of Ohio. Prof. J. B. Johnson also treats of the subject quite fully in his book, "The Materials of Construction," 1898, and in "Engineering News," Vol. 33, No. 16. The results of a valuable series of experiments on testing brick made at the Iowa State College by Prof. Marston are quoted in Engineering Record, April 1st, 1899. Much will also be found scattered through the numbers of "The Clay Worker" and various Journals and Reports of City Engineers.

If one is not satisfied by observation of a brick in actual service regarding its qualities, or if a number of different bricks are offered in competition, a careful comparative test by an expert tester will, I believe, be of great service in determining the relative merits of the bricks. As indicated by Prof. Johnson in the paper above referred to printed in "Engineering News," the method of making these tests and the comparison of results may now be standardized so as to admit of a "rating" and easy comparison, from which the brick having the greatest number of good points may be selected.

The plan of taking samples from the pile after the bricks have been delivered on the work as proposed by City Engineer Andrews of Albany, N. Y., in his Annual Report for 1898, seems a good one.

After the visit of inspection and a careful consideration of the information and experience obtained, the following recommendations were unanimously made to the City Government and are now being carried out:

RECOMMENDATIONS:

First: That vitrified repressed shale brick be used as a pavement in Prospect Street, Pearl Street, Portland Street and Harvard Square.

Second: That the particular make of brick to be used be left to the discretion of the Superintendent of Streets and the Committee on Roads and Bridges.

Third: That authority be granted the Superintendent of Streets to contract for the required amount of paving brick with or without advertising therefor at his discretion.

Fourth: That the pavement be laid in a base of cement concrete 6 inches thick, with a cushion of sand about 2 inches thick between the concrete and brick, and the joints be filled with Portland cement provided with expansion joints of asphalt pitch at proper intervals.

Fifth: That the work of laying the entire pavement be done by the day by the Superintendent of Streets.

Sixth: That before the pavement is laid all sewers and sewer connections, water and gas pipes and service connections be required to be laid to the curb line.

Seventh: That in case it is required at any time to open any street paved with brick pavement, the entire work of making such opening and restoring the pavement be done by the Superintendent of Streets and the entire expense of such opening and restoration be charged to the party, corporation or department requiring such opening to be made.

VICE-PRESIDENT THOMPSON: This will close the papers on the question of street paving. This entire subject with the papers relating thereto is open for discussion, beginning with the report of the Committee on Street Paving.

In brick pavements the material used for filling the joints is an important item. A large number of cities have adopted a Portland cement grout filler, but after having used such a filler in a few instances, and after observing the action of brick pavements in other places where this filler has been used, my conclusion is that Portland cement is not a proper material to use for such a purpose. It is not alone the question of expansion that is to be considered. Undoubtedly the bricks expand an appreciable amount during the hot summer months, and the Portland cement between the bricks expands also and cannot be compressed to allow for the expansion of the bricks. The natural consequence is that this expansive force accumulates until the pavement buckles, and cases have been cited where it has been forced up with a loud report as if from the explosion of gas. But in addition to this, a Portland cement filler makes a very noisy pavement. It accentuates the noises instead of deadening them. The third objection to cement is that every brick pavement, after it is laid, will settle—the least possible amount—to its permanent bed, even when the greatest possible care is taken with the rolling and tamping. This action is plainly shown by the settlement of the bricks about the castings in the street set on solid masonry. The Portland cement makes a solid masonry arch of the pavement, with the arch having for its support the curb line, and this arch will not settle and will not break through unless there is a weight on it sufficient to break the bricks. Brooklyn had a very serious example of such an arch. A fifteen-ton roller could not force it down, and the pavement was taken up and replaced with asphalt. In our city Portland cement grout has been used on two streets, on one of which this arch has been formed, and there is apparently a small space beneath the brick. The traffic has broken the bricks in some places and forced the pavement to its bed in a few small spots. These broken places are about three feet wide and five or six feet long, and they have settled below the general surface of the pavement. The formation of such an arch makes a sounding board of the pavement, and produces a roaring noise which is very undesirable, and where the traffic is very heavy it cannot be endured. The objection to the tar filler is that it becomes brittle in the winter and so soft in the summer that it will run out of the interstices. Sand makes a good, cheap filler, and fills all the requirements on streets with a flat grade. But on a street having more than a 4 or 5 per cent. grade it will wash out so badly that the bricks become badly worn by chipping on the edges. Sand and asphalt conform to the requirements of a good filler more nearly than any other materials that have been used.

MR. TILLSON: What do you mean by "Asphalt Filler"?

VICE-PRESIDENT THOMPSON: An asphalt mixture manufactured by some of the asphalt companies. I do not know the constituents used in it, but it performs the offices of the tar and is not so easily affected by the temperature; it does not become brittle in winter or soft in summer. The tar filler with the brick pavemens is simply the tar without any asphalt.

MR. TILLSON: In most of our granite joints, where the pavement is laid on concrete, we use what we call the tar filler, but it is made up of 100 pounds of tar, 20 pounds of asphalt, and 3 pounds of oil. I wanted to ascertain if Mr. Thompson referred to that.

VICE-PRESIDENT THOMPSON: The tar filler with the brick pavements is simply the tar without any asphalt.

MR. TILLSON: That is not used at all in the East.

MR. ADAM: Mr. Thompson says he would either use sand or a tar filler—

VICE-PRESIDENT THOMPSON: Not tar; either sand or an asphalt filler.

MR. ADAM: Is that tar and asphalt mixed?

VICE-PRESIDENT THOMPSON: No; asphalt.

MR. ADAM: Pure asphalt?

VICE-PRESIDENT THOMPSON: An asphalt preparation.

MR. ADAM: Where would you use sand and where asphalt?

VICE-PRESIDENT THOMPSON: I am an advocate of the sand filler because of its cheapness, and I would use that filler entirely on flat grades. On grades so steep that the sand would wash out of the interstices I would use asphalt.

MR. ADAM: If you use sand filler, that will allow more or less moisture to get in under the brick.

VICE-PRESIDENT THOMPSON: No, I do not admit that. We have taken up any number of brick pavements and never found any instances where the moisture would go through the sand filler.

Mr. Adam: Not in the first one or two years, before the sand on top would be coated with street dirt.

Vice-President Thompson: The sand, in the first place, is allowed to dry on the surface of the pavement, after which it is broomed thoroughly into the crevices, and a half inch is allowed to stay on the surface; so, when the first storm comes, it does not beat directly on the cracks, but on the sand, and forces it down into the interstices.

Mr. Adam: In the city of Newark I was forced to put a granite pavement on a two-inch cushion without any dry filling in the joints—they thought it was superfluous. There was only one street done that way; and I find the blocks were very uneven in surface, not as even as where the tar and gravel is used; and I ascribed it in a measure to this, that the water got under the stone and the frost in the winter would have an effect, and I thought that would have an effect on brick also.

Vice-President Thompson: The spaces between the blocks of granite are sufficiently large to allow the water to form a pool and soak through; but the spaces are so small between the bricks, the moisture is not afforded the same opportunity to permeate the filler.

Mr. Adam: That was my opinion, and I told the parties that this would be the case. My views in this matter have not been corroborated. I would like to hear from some persons in this convention whether they can support my opinion in regard to a granite block pavement upon a concrete foundation. I consider it far better not to lay a concrete base, when only a sand filler is to be used. Even this extreme view has been taken at home, that a stone-block pavement is as good on a sand foundation as it is on one of concrete, contrary to the recommendation of the Engineer.

Mr. Tillson has stated this afternoon that in his opinion there was a difference of five (5) years in the durability of a granite-block pavement when laid on a concrete foundation, and one laid merely on sand. I believe the difference to be even greater, for the reason that the surface of the pavement, when laid on sand, soon gets uneven through the action of the frost, and then the blocks are rounded off in a short time, making the surface rough. This is one of the principal reasons that people ask for either asphalt or brick pavements.

A MEMBER: I would suggest the sand filler on street grades of 12 or 14 per cent. We have had them ten or twelve years.

MR. ADAM: Without washing out?

MR. ELDRIDGE: I can support Mr. Thompson's statement about the dryness of the sand filler; it is illustrated in a case in my town where a water valve sprung a leak, and an attempt was made to stop it. Several days were spent at it, the leak running at a pressure all the time of about sixty pounds. Finally an excavation was made, and I found within a foot or so of the valve box it remained perfectly dry—that the water had not even penetrated laterally in the sand cushion.

MR. J. WALLACE, St. Thomas, Ont.: I would like to ask your opinion with regard to brick pavement, using the concrete filler and every twenty-five feet using a joint with asphalt filler to allow for the contraction and expansion of the work, and also using a similar expansion filler on the curb and street lines. Mr. Thompson said just now that the bricks were liable to form an arch over the foundation. Would not that asphalt filler, say every twenty-five feet, remedy that so as to allow the brick to settle, using the filler every twenty-five feet in one strip right across the street, the same on the curb line?

MR. ADAM: I have adopted that method in some pavements laid in the city of Newark. I left an inch space along the curb and a width of one foot of the brick pavement from curb to curb, at intervals of 25 or 50 feet; these interstices were filled with a mixture of asphalt and coal tar. In several streets this was a success, in others a partial one, and in one paved last year the noise is as bad as in those that were paved in 1895, and which prompted me to prepare the papers treating upon the subject, "Rumbling in Brick Pavements," that were read at the Conventions of the Society held in 1896 and 1897.* I must agree with Mr. Thompson, after my experience, that the safest way of obtaining a noiseless brick pavement is either to use a sand or an asphalt filler.

VICE-PRESIDENT THOMPSON: The spaces thus provided would certainly have a tendency to lessen the danger from longitudinal expansion. But the roaring is not caused by the expansion of the pavement transversly; it is caused by the pavement failing to settle to the sand bed. That it is not caused by the transverse expansion can be shown in every case by an examination of the brick along the edge of the curb line. Wherever this roaring has existed there is no instance shown of any movement of the pavement along the curbing. If the brick pavement had expanded there would be a movement along the curb line, or the form of the pavement would be changed, thereby breaking the joints. Therefore, the strip which is placed parallel to the curb would have no tendency to decrease the roaring in the pavement. The spaces which are placed at intervals across the street would have a tendency to take up some of the expansion.

MR. AMES: It strikes me that the arch that is said to form in the pavements is very flat to sustain the loads passing along the street; and I have wondered if it was true that it was an arch formed in the street that caused the rumbling noise.

VICE-PRESIDENT THOMPSON: Mr. Tillson can probably give some information based on their experience in Brooklyn.

MR. AMES: We paved a street in Grand Rapids, part of one side of which was filled with Portland cement grout, and the other with coal tar pitch; and there was rumbling on the side where the Portland cement was used; but, though each side was equally smooth, where the pitch was used there was no rumbling. My idea is that the Portland cement filling made a solid mass of pavement from which the vibration of one brick was transmitted through the mass to another brick, and that this vibration and consequent noise continued to accumulate until it produced the rumbling noise; but where the pitch was used, the pitch being soft, it did not transmit the vibration from one brick to another, and consequently there was none of the rumbling.

MR. TILLSON: I do not think that placing the asphalt along the curb will do a particle of good as far as noise is concerned. We went into that pretty carefully in Brooklyn in the case to which Mr. Thompson has just referred; in that case we paved two streets and filled the joints with Portland cement. It was rather a peculiar case, because after the pavement was laid and the bricks were rolled there came a cold spell, and the sand under the concrete froze solid before the joints were poured; and after it warmed up we tried with hot water to thaw out the sand under the brick; but I never was satisfied that we got it thoroughly done, and I have always thought that was the reason that caused this rumbling. There were two blocks adjoining, and there was a great deal of rumbling, especially on one of them—there was quite a little on one, but on the other a great deal—and the property owners on the block complained so much to the Commissioner that, after trying a good many experiments, we took up the brick and relaid asphalt—not, as the Chairman said, because we thought the pavement was poor, for we thought it was good; but it was done to satisfy the people. Before we took up that pavement we went along by the curb and chipped away the brick, and got an open space between the pavement and the curb of nearly two inches, allowing plenty of room on each side; and after that the noise was just as bad as it was before. Then we took a fifteen-ton macadam roller and put it on that one block and rolled it over for a day; and the rumbling was just as bad after as before. I do not think now and I never did believe there was ever any arch there, but that the whole cause of the rumbling was on account of the little cavities under the brick. Perhaps the bricks were not rolled quite as hard there as others, or when they became frozen and afterwards thawed that it left little cavities and that the whole pavement was underlaid with these little cavities under the concrete, because when a vehicle would be passing over it one wheel would strike a place perhaps as large as this table, and you would hear the rumble, and then the rumbling would stop. This rumbling would be intermittent—it would not be continual—but you could find it by tapping on the pavement, all 'round, showing there were irregular cavities scattered under the pavement. I do not believe it was caused by any contraction or expansion, because in the width of the street the co-efficient could not be enough to make an arch—in 34 feet. And we had some noise in a street that was laid in hot weather. I do not believe any expansion joint will do any good for avoiding noise.

Mr. Adam: In a street which was paved two years ago with shale brick, about 600 square yards, or about one-tenth of the entire surface, is in need of repairs. It seems that some of the bricks were over-burned, making them brittle. The contractor was ordered to repair the pavement, and therefore wrote the manufacturers to furnish him with new bricks, stating that a number of them which had been sent were too brittle. It is said that the manufacturers sent a competent person to ascertain the cause of the breaking of the brick. He not only made an examination of the pavement in this particular street, but also in other streets paved with brick. He attributed the cause to the want of sufficient expansion-joints—consequently assuming an expansion in brick pavements.

I do not wish to enter into a similar debate upon this subject which took place two or three years ago at the Convention. Mr. Tillson, at that time, was of the opinion that the rumbling noise produced in one of the brick pavements in the city of Brooklyn was due to the shrinkage of the cushion-sand, which was said to have frozen during the construction of the works, thereby leaving a void under the bricks after moisture was thrown off, and consequently causing a noise.

The expansion is not alone lateral, but also longitudinal. In one of the streets, which was paved in 1895, a slight elevation in two or three rows of brick can be noticed at intervals of about fifteen feet, and the cement grout broken away in a single transverse joint from curb to curb. This is certainly due to longitudinal expansion. It is therefore evident that there is expansion in brick pavements, and where cement grout has been used for filling the joints the bricks are prevented from settling back upon the sand cushion, leaving a hollow space underneath, and consequently producing a rumbling noise.

In another street where fire-clay paving brick were laid with a cement filler on the apex of the grades—but I cited the case once before, yet there are new members present--there occurred a break forming an arch of nine feet span and a rise of eight inches; some persons living along that part of the street say that the break caused a loud report.

The pressure upon the brick by the expansion was so great that quite a number of them showed a horizontal rupture, and no breaking of the edges, as was claimed by the manufacturers spoken of in another case.

MR. TILLSON: Was that expansion lengthwise of the street?

MR. ADAM: Yes, but the break was transversely to the line of the street, extending from curb to curb. The temperature was 94° in the shade at the time the break occurred, which was in May of the following year that the pavement was laid during a temperature of 25° above zero; consequently the pavement had been subjected to a great change of temperature.

It is best to lay a brick pavement during the hottest part of the summer, when the bricks are in a condition of greatest expansion.

Vice-President Thompson here retired, and the President resumed the chair.

THE PRESIDENT: Were the joints formed at that temperature?

MR. ADAM: Yes. And to convince myself that there was a longitudinal expansion I examined the cement joint along the curb-stones, and found that the cement had lost its bond with the curb for a distance of about 200 feet on each side of the rupture, showing that the bricks had shoved along the curb.

I think there is quite another vital question relaiing to brick pavements. It is my view, and I would like to hear whether it is corroborated, that when either sand or pitch is used as a filler the durability of the pavement is impaired. In my opinion, it is diminished at least five years. This conclusion is not only arrived at from theory, but also from examinations of pavements laid in Newark and other cities. I would like to hear the opinion of other persons who perhaps have had a greater experience.

Mr. Ames: In the instance I spoke of, on one side of the street there was Portland cement filler used, and on the other side pitch; then, further down, they changed it over and put the Portland cement and the pitch on opposite sides. That was done to see what the effect would be. The following year there was some—I can hardly call them complaints, but several people mentioned there was rumbling in that street, that the concrete must have settled. I made an examination of the surface of the street, and there seemed to be no settlement whatever; and as I walked along the street I noticed that the rumbling was all on the portions of the street that were filled with Portland cement. It did not seem to be a continuous rumbling. I do not believe there is any undue settlement of those places more than the settling on the other portions of the street where pitch filler is used; and it seems to me that rumbling is due to the fact that vibrations from the vehicles and feet of the horses are transmitted from one brick to the other when the pavement is thoroughly filled and the Portland cement has become hard. Where the filling is less perfectly done, or where it has been broken up before the cement is thoroughly set, there would not be the tendency to transmit that vibration from one brick to the other. Where the Portland cement is set you get a ringing sound such as would come from two bricks when struck together. But where you have a pavement filled with asphalt or coal tar you have a different medium, and there would be no transmission of vibration from one brick to the other, which I think is the reason why you get the vibration where your pavement is thoroughly filled with cement. If it were imperfectly filled there would be less vibration; or perhaps no vibration at all, if it were very poorly filled.

Mr. Adam: Vibration, in my opinion, would not produce any noise unless there was a hollow space, which is the same as striking the strings on an instrument; unless you have a hollow space the vibration could not produce any noise.

Of course, any pavement will produce a noise. I am not speaking of that; I am speaking of the nuisance of the rumbling noise. I believe property owners have no just cause to complain of the ordinary noise produced by the rolling of wheels over any kind of street pavement.

THE PRESIDENT: Do you not notice that the noise of the impact of wheels on pavement, filled with plastic material, is less than where Portland cement filler is used.

MR. ADAM: Yes, where a cement filler was used there is a rumbling noise.

THE PRESIDENT: I do not mean that; I mean the noise of the impact of the wheels on the pavement.

MR. ADAM: I cannot answer this definitely.

MR. FISHER: I want to say a few words in regard to this matter, because the conclusions of Mr. Hastings, I think, were influenced by his observation of the practice in Rochester last year with respect to filling joints in brick pavements. We built a brick pavement about three-quarters of a mile long, late in the season. It was finished in freezing weather—we used a steam jet to thaw out the sand in order to get it in shape to lay the brick on. We put in expansion joints at the curbs; we put a ¾-inch board next the curb, and laid the brick against this board, and then took the board out and filled the space it left with paving pitch. We also put in about three to four joints of paving pitch in every thirty feet, and these joints we filled before we did any grouting. The balance of the joints were filled with Portland cement grout, mixed,—one cement, one sand. The bricks were laid very close. This summer, during the hot weather, some rumbling was noticed on this street, and a short time ago I made an investigation and reported the result to Mr. Hastings. The rumbling seemed to be at these pitch-filled joints; but upon careful examination we found that the rumbling occurred about three feet on each side of these joints, and on a portion of the street only—on that portion of the street laid in the coldest weather and under the worst conditions there is no rumbling. On another portion of the street the rumbling during the hottest weather was quite disagreeable. At the time I examined it, about two weeks ago, the weather was somewhat colder, and it was not very noticeable; it was almost drowned by the horse's hoofs striking the brick pavement, and by the rattle of the wheels.

The reason for this rumbling, I believe, is this: The bricks were quite smooth, the joints were laid very close, and I do not think we have in some places any room for expansion whatever. I think the bricks are in contact. In the pavements we are laying this year we are taking more pains to see that we do get this expansion joint.

The street in question was 38 feet in width between curbs. A double track railway occupied the center of the street for nearly the entire length. The tracks were laid on Portland cement concrete 12 inches deep. Iron ties made of old 4½-inch rail, placed 6 feet apart, were used. The portion of the pavement outside the railway tracks had a 6-inch natural cement concrete foundation. Sand cushion, 1 inch.

MR. ADAM: I notice quite a great deal of rumbling noise in this place. Can any of the officers of Toronto say whether there is any brick pavement here that needs expansion.

MR. FULLERTON, Q. C.: It needs a good filler.

MR. TILLSON: I meant to have said that where we had those two blocks in Brooklyn that gave so much trouble when first laid we relaid one in asphalt, and there is no trouble with the other one.

MR. ADAM: I would like to have my question answered as to the durability of brick pavements when sand or pitch is used as a filler.

MR. THOMPSON: Mr. President, I agree with Mr. Adam, that a brick pavement having an asphalt or Portland cement filler is not subject to so great a wear by chipping of the brick at the edges as where the sand filler is used, but even the Portland cement filler breaks away and leaves a depth of brick, generally from a half inch to an inch, which is exposed to the chipping. This wear is such a small factor, however, compared with other influences which determine the life of a brick pavement, that I do not believe it should be taken into consideration. A brick pavement on a residence street, not disturbed by openings, will, with proper care, give results that will fully satisfy any man who is paying for it, because it will last longer than the man.

MR. TILLSON: I am willing to go on record to support Mr. Adams theory, that if you get a good Portland cement joint in your brick pavement, if the pavement has to stand any heavy traffic it will last five years longer than the sand joint. I believe that thoroughly, for this reason: If you put in a good joint that is successful it will keep your pavements smooth and you are wearing on a smooth surface all the time; your wheels roll evenly and you do not have half the abnormal wear that you do if you have the edges an uneven surface that you must have with a sand joint. I do not think there is any question about that.

And as the President has referred to that note I made from the Engineer of Minneapolis, the brick manufacturer was not willing to guarantee his brick for more than five years unless a sand joint was used, permit me to say he was the other way.

THE PRESIDENT: The testimony of this brick manufacturer does not seem to me to be conclusive evidence any more than the testimony of the other brick manufacturer who came to Newark in an endeavor to find an explanation as to why his brick chipped.

Is there any further discussion on this question? This paper by Mr. Broadhurst on the physical properties of asphalt ought to be productive of some discussion, and I know we should be very glad to hear from Mr. Whinery on the subject.

MR. WHINERY: You are very kind to ask me to take part in the discussion of this matter; but I think, under all the circumstances, I would prefer not to, if you will kindly excuse me.

MR. ADAM: The subject that was brought up by Mr. Broadhurst is almost entirely based upon the technical results of a chemist with years of experience, which engineers and laymen have had no opportunity to acquire; nevertheless, as Mr. Broadhurst is here, I would like to ask him some questions relating to matters which have developed while laying asphalt pavements during the past year in the city of Newark. But, if I am permitted, I would like to make a statement of the work done in 1898, and as to the prices, before I put the question.

Previous to the year 1897 the specifications for laying asphalt pavements in Newark permitted the use of Trinidad Lake asphalt only. In order to obtain a reduction in the cost of asphalt pavements it was concluded to allow the use of other kinds of asphalt. Therefore a new form of specification was drawn up, permitting the use of Trinidad Lake, Bermudez, Alcatraz and Sicilian asphalts; but no other bids were presented than for Trinidad Lake asphalt. The price paid was $1.80 per square yard in one instance, and $2.35 in four other cases. In 1898 the Board of Street and Water Commissioners (or Broad of Public Works) and His Honor the Mayor resolved that the specifications should be made still broader, allowing all kinds of asphalt. New specifications were again prepared in which no particular kind of asphalt was mentioned, but the best pavement obtained with the use of Trinidad Lake asphalt was made the standard. The year's work of asphalt paving, 250,000 square yards, was done by four companies, namely: The Barber Asphalt Paving Company, the Atlantic Alcatraz Asphalt Company, the New Jersey Asphalt Company and the Newark Paving and Construction Company; using Trinidad Lake, California asphalt from Santa Barbara County, California asphalt from Ventura County, and Trinidad Land asphalt, respectively. The prices ranged from $1.39 to $1.75 per square yard of the Barber Company; the average was $1.57—$1.65 to $1.68 of the Alcatraz Company, average $1.658—$1.38 to $1.79 of the New Jersey Company, average $1.57—$1.41 to $1.51 of the Newark Paving and Construction Company, average $1.44.

The new specifications require a ten-year guarantee for the pavement, but a payment of 25 cents per square yard is allowed the contractor in addition to the price bid, payable yearly after the first period of five years, for keeping the pavement in good repair for the second period of five years. This action was taken by the Board upon the recommendation of the City Counsel, who was of the opinion that the court might not confirm the assessment for the paving improvement, on the ground that it was unjust to make property owners pay for the maintenance of one class of paving improvement for a longer time than for other kinds. The guarantee for maintenance of a stone-block pavement was increased from one year to five years, whether on sand or concrete foundation, and the guarantee for brick pavement is also for five years; therefore it was thought it might meet with opposition in the courts, if the guarantee on asphalt pavement would be increased to ten years without providing for a special maintenance fee.

When the low prices obtained last year were announced in several engineering journals and newspapers I received a great many applications from city officers of other places for a copy of the new specifications, supposing on their part that it might be a special form which caused the extreme drop in the prices, perhaps not being informed of the additional allowance of 25 cents per square yard to the price bid. But the parties which received a copy will have found that the specifications were even more exacting than any of the former, especially in the conditions for repairing, which are a copy of those recommended by the Committee on Street Pavings of the Society, at its Convention held in Nashville in 1897. It was the competition, but perhaps more the intention of slaughtering each other, that caused the low prices.

Both the Barber Company and the New Jersey Company have local and permanent plants. The other two were working with portable plants, which arrived so late in the season that some of the work was done in the month of December. All of the companies but the Barber Company, which had all of its work done in seasonable time, were compelled to remove the snow several times from the binder before the wearing surface could be laid. in a number of instances the asphalt was laid when the temperature was below freezing point—as low as 18° above zero. Only in one street did the pavement materially suffer by being laid in such weather, showing quite a number of fine cracks after the exposure during the winter. In all streets it was difficult to keep the edge of the asphalt already laid in such a condition as to obtain a smooth and perfect joint when an additional batch was laid, on account of the chilling of the material that was already laid. From the experience and result of last winter's work I could not encourage any engineer to allow work to be done under like circumstances.

It is fair to state that one of the companies did not complete all of its work contracted for, and since then its affairs have been in the hands of a receiver.

The Board allowed me to engage a chemist to make a chemical analysis of the asphalt material as it was laid on the street. I took a number of samples from each street and brought them to the chemist. The specifications say that the bitumen contained in the asphalt material should not be less than 9 nor more than 12 per cent.; in one or two instances it was over 12 per cent., this being the case where the pavement was cracked.

I was informed by chemists on several occasions that it was impossible to tell by an analysis what per centum of the total amount bitumen contained in an asphaltic mixture is of asphaltic origin, or due to residuum oil of petroleum, when both materials are used in the same mixture.

On a former occasion, in making tests of asphaltic mixtures, there was a difference of 1.23 per cent. in the result of the analyses, made by two chemists, of the same piece of an asphalt pavement.

I was also informed by a chemist that he found a difference of 2 per centum of bitumen in pieces taken from the four corners of a slice of asphalt pavement six feet square, which was taken up in one of the streets of the city of New York.

Will Mr. Broadhurst, who, I have no doubt, made a great many examinations and analyses of asphalt paving materials, tell whether it is possible to determine the kind of bitumen contained in an asphalt wearing surface, when other than natural asphalt is used in the composition. The pavement in which the cracks had developed was said to have been laid with California asphalt of the "Ventura" brand, or from Ventura County, according to a sworn statement submitted to the Board by the contractor.

MR. BROADHURST: Is the question whether the pure asphalt or adulterated asphalt was used?

MR. ADAM: No; it is whether, by a chemical analysis, it can be ascertained what part of the total bitumen found in the mixture is asphaltic bitumen, residuum oil of petrleum or some other substance which might have been used.

MR. BROADHURST: I would say it is not possible to determine the amount of each kind of bitumen in an asphalt pavement, but it is possible to tell whether petroleum residuum is there or not. The method for determining "ductility" which I have just described in my paper would tell that. The pure bituminous matter is much shorter when petroleum residuum is present. Other tests would also show it.

MR. ADAM: Could you ascertain the exact quantity of each?

MR. BROADHURST: It is not possible; the chemistry of the subject is not yet sufficiently developed along these lines. You can tell, however, whether it is there or not.

MR. ADAM: What proportion would be asphaltum and what petroleum residuum?

MR. BROADHURST: It would be hard to determine exactly, but you could come to an approximation.

MR. ADAM: How close an approximation could you come to?

MR. BROADHURST: Within 5 to 10 per cent. of the amount added.

MR. DRAKE: I would like you to say what effect it has on the life of the pavement.

Mr. Broadhurst: Other things being equal, the life of a pavement containing petroleum residuum is shorter than that of a pavement containing good maltha as a flux.

Mr. Drake: I ask the question because we have some pavements in Buffalo which show the cracks such as Mr. Adam has mentioned, and we refused to accept the pavement; and the contractor insists that the cracks do not injure the pavement at all. We are watching it very closely, and any information bearing on the subject would be of interest.

Mr. Adam: I should think that if any of the street dirt should get into the fine cracks it would prevent any cohesion of the asphaltic material.

Mr. Drake: Then it would ultimately result in damage to the pavement?

Mr. Adam: I would take that view unless the joints would be thoroughly filled.

The President: I noticed quite a large number of cracks in some of the Toronto pavements. I think the climate here is a pretty severe one, and I am sure testimony from Mr. Rust—or from Mr. Whinery, if he would speak from the asphalt standpoint—would be of value, as to the actual effect of the crack on the wearing qualities of the pavement. Mr. Drake asks the question as to the effect of small cracks which appear in asphalt pavements, similar to those which are noticeable in Toronto, on the wearing qualities and ultimate life of the pavement.

Mr. Rust: I think they will affect the ultimate life of the pavement, although at the present time we have done little towards repairing them. It depends; if the cracks widen out at all the asphalt must begin to disintegrate. The very fine cracks I do not think will affect the pavement. Strange to say, the cracks which appear are on the streets where there is very little travel; while on the streets where the travel is moderately heavy there are no cracks to amount to anything. Also, on the streets where street car tracks are laid in the center the cracks have not amounted to anything.

MR. TILLSON: I think, Mr. President, that there is not any question but what these cracks do affect the life of the pavement, but the rate they affect it depends entirely upon the climate of the city; if there is not any very great range in temperature the cracks do not do so very much harm. The first experience I had with cracks in asphalt pavement was in Omaha, where we had a variation in temperature of probably 150° between summer and winter; and as a rule, when we have our extremely cold weather there is no snow on the ground.

Of course these cracks are caused by contraction, and when we have the coldest weather we have the greatest amount of contraction and the cracks are the widest. When the pavements were first laid there they did not crack materially until after they had been down about two years. Then the cracks began to show; and, as I said, in the winter, as the cracks begin to open, especially if there is much traffic on the street, the asphalt being hard, the edges of the cracks crumble; and they go on that way, crumbling a little more, and after they have begun to crumble that way in the winter they cannot close up in the summer. If the frost is not so hard in the winter as to cause the asphalt to crumble, when the warm weather arrives the cracks will close up. But in Omaha, in a good many cases, we had, at the end of five years, cracks that were started as individual cracks I suppose, perhaps six inches wide with a depression in the center, and then made up of cracks approximately parallel to the central crack; and those would have all to be repaired in order to have the pavement in good condition. In driving over one of these pavements you would feel the motion of the wheels going in and out of these cracks.

MR. ADAM: Does Mr. Tillson mean the cracks which sometimes occur in asphalt pavements, extending from curb to curb, or the small hair fissures?

MR. TILLSON: I do not exactly know what Mr. Adam means by these "small hair fissures." I mean cracks as in Omaha that would go across the street; or, if there was a car track in the street, would go from the track to the curb; and if they were frequent enough—say 15 or 20 feet apart—sometimes there would be a cross-crack joining them, and that would continue, so that sometimes the road would be divided into irregular blocks.

I do not know just what these small cracks are caused by; I do not believe they are caused by changes in temperature. Some of them crack irregularly without anything seeming to govern them one way or the other.

Mr. Adam: I was of the opinion that when the asphalt material does not contain a proper amount of bitumen it is liable to crack in the winter time; but only a few cracks developed in the whole block of 1,700 feet in length. In another street that was laid several years ago, where the asphalt wearing material was so soft that a knife blade could be pushed through it a few days after it was laid, there are now several large cracks in the pavement, extending almost across from curb to curb. I was always of the opinion that when an asphalt pavement was ductile, that it had no tendency to crack. I would like to hear the views of others upon this subject.

The President: Is there any further discussion? If not, there is a paper which has not yet been read, but I think it may be well to postpone the reading of it until this evening. I refer to Mr. Eldridge's paper on "Portland Cements." There is also a paper of Mr. Bouton's on the subject of "Taxation and Assessment" to be read, but it is now a quarter to six o'clock.

Mr. Thompson moved, seconded by Mr. Tillson, that the reading of these papers be deferred until this evening, and that they then be made the first order of business.

The President put the motion, and, on a vote having been taken, declared it carried.

Mr. Tillson moved, seconded by Mr. Fisher, that the meeting do now adjourn to meet at 8 o'clock p. m.

The President put the motion, and, on a vote having been taken, declared it carried.

EVENING SESSION.

Wednesday, 4th October, 1899, 8 o'clock p. m.

THE PRESIDENT called the meeting to order.

Paper by Mr. Harold P. Brown, Electrical Engineer, New York, on "Rail Bonds vs. Water Pipes," was received by the meeting, and on motion was ordered to be printed in the proceedings.

RAIL BONDS VS. WATER PIPES.

BY HAROLD P. BROWN, ELECTRICAL ENGINEER, NEW YORK.

During the past year several cities have discovered electrolytic troubles of their own and in most cases have promptly antagonized the electric railway interests instead of joining them to secure the best results for all concerned with the least possible delay and expense.

This is unfortunate since deadlocks and lawsuits, like those at Peoria, Ill., are interminable and vexatious. This Peoria case, by the way, is to be carried to the U. S. Supreme Court to establish whether or not electric railways can be made responsible for electrolytic injury of water pipes.

There have recently been many consolidations of electric railway interests and these have occasionally done much to relieve the water pipes of their dangerous load.

A small electric road generally cannot afford to employ a high order of talent either in engineering or financial departments.

Its manager is often satisfied with a shoestring copper bond and its engineer, if it has one, cannot afford the expensive testing apparatus or does not realize the importance of maintaining a return circuit of low resistance.

Though the consolidations may leave men of this class in charge of divisions, they frequently place competent men at the head of the business and technical management and give them ample resources to obtain good results. These men are anxious to build up their reputations by their thorough work and they pay careful attention to every detail that means economy in operation. On the other hand, miserly reduction of first cost with heavy running expenses is often the policy of the small road.

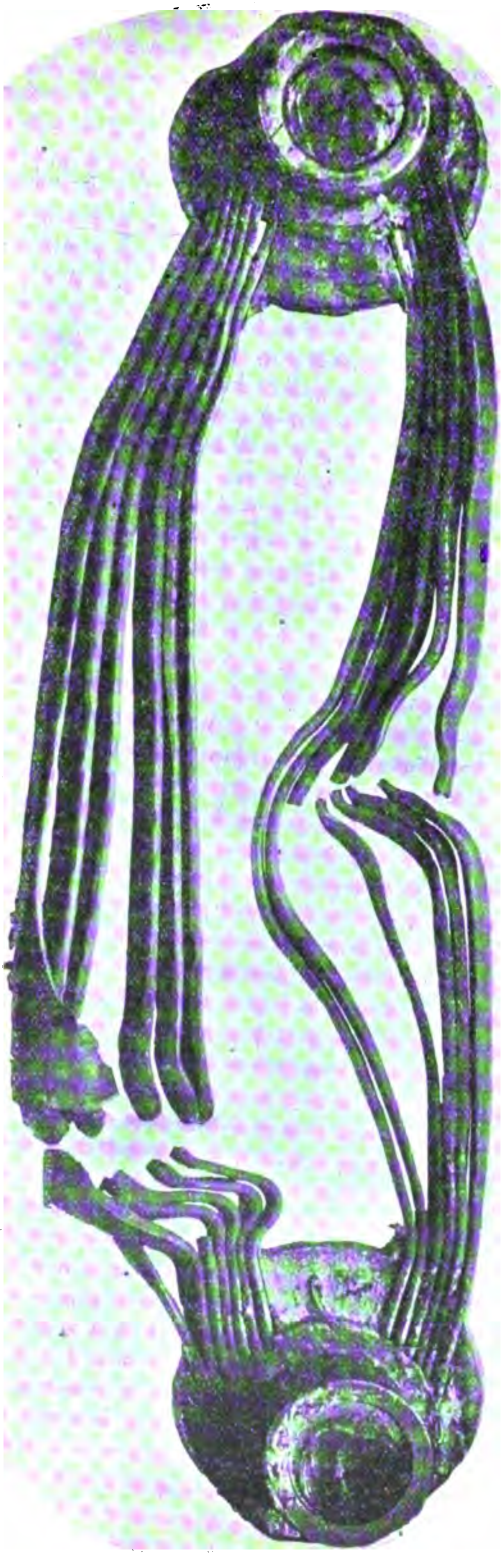
As a class, electric railway engineers have learned that poor bonding may double the cost of their power and seriously injure the water pipes, and that ideal conditions are realized when the bonding has a permanent conductivity equal to that of the rail.

Many of them have found from experience that a copper wire rivetted into the rail is bad at the start and grows worse as time passes. About two years ago this type of bond was discredited by the advanced men and thousands of short, flexible copper bonds were used, generally placed under the angle plate. These were bands of thin copper strips, or cables of small wires, on the ends of which projecting lugs were cast or brazed to form terminals.

Holes ⅝ of an inch to ⅞ of an inch in diameter were bored into the web of the rail, into which these terminals were expanded by screw pressure or by driving a tapered steel plug through a hole in the lug. The former method gives the better mechanical results, as was proved by tests made by Mr. W. D. Wright, E. E. of the Union Railroad, Providence, R. I. After setting several of these types of bonds in holes ⅞ of an inch in diameter through a steel plate ½ of an inch thick, a horizontal lever 18 inches long was attached to each and weight gradually placed upon the end of lever until the friction of the terminal was overcome.

The screw-compressed terminal turned with an average weight of 143 lbs., while the terminals with taper steel plugs required but 65 lbs. At first this seemed a decided advantage in favor of screw compression bonds, but experience has proved the opposite for this bond was set so tightly that all the motion of the rail ends was concentrated upon the copper strips. The result is shown in accompanying full size cut from photograph of a bond removed from a road in Cripple Creek, Colorado, after but one year's use on well ballasted track with heavy rails and tight, well maintained joints. The cut shows a bond whose terminals are ⅞ of an inch in diameter and are in excellent condition. There were originally twelve copper bands 3-16 of an inch wide and 1-16 of an inch thick, and ten of these have parted. Examination shows that the ends of these bands are crystallized. Thousands of bonds have already given out during the first year's use and require replacing. Since they are covered by the angle plate and the bands give out one by one, their bad condition may escape notice for a long time, while the breaking of a bond made of a single wire is at once evident.

The other bonds having a poor mechanical joint do not put so severe a mechanical strain on the copper wires and therefore last longer. But the looseness that helps them mechanically, allows moisture to penetrate between the copper terminal and the sides of the hole in rail, thus making a coating of rust of high resistance which cuts down the carrying capacity of the bond. It is evident, as stated recently by a prominent railway manager, that no engineer would hang a heavy door on hinges made of flexible copper cable, since he would know that after a certain number of bends the copper wires would crystallize



and break. It will in time be recognized that every rail joint however solid in construction, must move as car wheels pass over it; and that any copper bond however flexible will sooner or later break if fastened at the ends. And when this is realized, it will be better for the water pipes.

A promising copper bond has recently been designed in which the conductor is a solid piece of copper ⅛ of an inch thick, 3 inches long and 1¾ inches to 2 inches or more high.

It has a projecting contact cup pressed on each end and is placed under the angle plate so that one cup touches the web of one rail and the other cup the end of the adjoining rail. The bond is held against the rails by a strong steel spring placed in each cup and compressed by the tightening of the angle plate. Each spring rests on a disc of sheet steel so that it cannot cut into the copper, and gives a pressure of about 1,000 lbs. per square inch.

This bond is tightened by setting up the track nuts. I regret to say that the electrical condition of the water pipes at Dayton, Ohio, is still unsatisfactory and the installation of cast-weld joints on some of the lines has had no beneficial effect.

I had planned to report to you the result of further electrical tests in that city, but the work has been unavoidably delayed.

In Evansville, Ind., there has been serious damage done to the water pipes. The railways there plan to replace any missing bonds with a No. 0 wire which is little larger than a shoestring.

I am informed that they wish to make frequent connections between the rails and water pipes in all parts of the city, thus offering every inducement for the current return on the pipes instead of on the rails. This of course should never be permitted.

In Franklin, Ohio, where an electric line has been in operation about two years, lead service pipes have been renewed four times in the past year in some places. The pipes are said to be 28 volts positive to the rails at several points. Anyone could obtain free electric power and light by putting motors or lamps in circuit between the water pipe and the rail.

At Indianapolis, with a maximum current of 2,800 amperes from the power house, the water pipes are carrying 1,400 amperes with a maximum positive pressure of 8.2 volts.

This means more than 150 horse power at work to injure the pipes. These measurements were made since the general installation of the cast-weld joints which are advertised as good conductors.

Previously under similar conditions, the highest reading of positive pressure was 6.8 volts. This shows that the cast-weld joint is even a worse conductor than the small copper bonds formerly used on the rails. But this is not the whole story; according to Mr. Brownell, who had made the electrical tests, not only had the positive charge of the water pipes increased 20 per cent. since the adoption of the cast-weld, but the area in which the pipes were in dangerous condition had been doubled. The railways, I am told, put in these joints with the expectation that they would prove such good conductors that the water pipes would be relieved of their electrical load. But the conditions have been made much worse and the railway has been sued for damages.

At Logansport, Ind., the ends of the railway return wires are carefully dropped into an open well. They might as well connect them to a hitching post! I do not know what bonds they use; but about half of their track is said to be without bonds. As a result, with only 200 amperes output from the power house, the water pipes are about 18 volts positive to the rails. From many other cities comes the same story with endless variations; poor bonds and injury to pipes.

In conclusion I again urge the importance of thorough and frequent electrical inspections of the water pipes and friendly consultation with the railway managers when dangerous conditions are found to exist. And again I advise the insertion of lengths of iron-banded wooden pipes into the water mains at intervals so as to make the mains of less conductivity than the rails.

This with good bonding, suitable and properly balanced return wires from rails and water mains and continued electrical tests, will prevent any serious trouble from electrolysis.

HAROLD P. BROWN.

120 Liberty St., New York, Oct. 2, 1899.

MR. O'BRIEN: Since we adjourned this afternoon I have heard quite a number of members talking, and they think that discussions on the papers read here should take place at the time, because when four or five or six papers are read, and you then undertake to discuss them all together, many things are overlooked; while, if they were discussed when read, a more satisfactory discussion could be had. I now move that the papers be discussed when read.

A MEMBER: I second the motion.

THE PRESIDENT: It is moved and seconded that discussion immediately follow the reading of each paper.

When we had a group of papers on one subject, as in previous Conventions, and the discussion was likely to be interminably prolonged so as to prevent the completion of our program, it was thought well to postpone discussion on each subject until all the papers on that subject had been read.

MR. O'BRIEN: That would be all right.

THE PRESIDENT: I now understand Mr. O'Brien's motion that discussion immediately follow the reading of each paper, unless there are a number of papers treating on the same subject. I will put the motion as I understand it, although I think it is only in conformity with the present practice of the Society.

THE PRESIDENT put the motion, and, on a vote having been taken, declared it carried.

Paper No. 17—"Taxation and Assessment"—by Mr. George T. Bouton, Secretary Street and Water Commission, Jersey City, N. J.

MR. BOUTON: This is not a technical paper. A year ago I spoke at the Convention on what I then thought to be a necessity which existed for more lay papers before the Convention. I thought it would attract laymen; and while the technical papers are of immense value, it would be more beneficial if there were a certain percentage of papers presented which would be understood by the laity as well as by the gentlemen who are, by special education in the various lines, capacitated to prepare papers on technical subjects. The paper I am now about to read is neither technical nor lengthy.

TAXATION AND ASSESSMENT.

BY GEO. T. BOUTON, SECRETARY STREET AND WATER COMMISSION, JERSEY CITY, N. J.

MR. PRESIDENT AND GENTLEMEN:

As a member of the Committee on Taxation and Assessment, an honor which has been accorded me by our President, I will beg the indulgence of the members of this society for a few minutes, while I glance over a portion of the subject indicated. For the reason that I am thrown in almost daily contact with the subject of municipal assessment, and am therefore the more familiar with it, I would, with the permission of the President and your acquiescence, confine my remarks to that particular problem of government: for it is oftentimes a problem indeed.

We will doubtless agree that, as an abstract proposition, all assessments for public improvements should in law and equity be based on the benefits accruing to real estate by reason of the making of a certain improvement, the cost of which improvement should be pro-rated on the several properties benefited, and to the extent of such benefit; but as public improvements (and I refer to paving and sewer work) cost the same, whether the properties benefited are worth one hundred or one thousand dollars per city lot, the more valuable property would probably be benefited to the full extent of a pro rate of the entire cost, while to so assess the less valuable property would oftentimes resolve itself into a practical confiscation.

The law which governs our city precludes the making of an assessment beyond the actual benefit derived, and thus at times the city is compelled to assume a share of cost, because the making of the improvement petitioned for appeals to the governing body as of sufficient general benefit to warrant the expenditure; but experience has taught us that the greatest care should be observed in the exercise of this prerogative as increasing demands for partial exemption are strengthened with each concession.

I have heard individuals argue for the favorable consideration of a petition for an improvement, the benefits of which would be largely local, and the making of which would result in the city's assuming quite 50 per cent. of the cost, the petitioners admitting that the improvement was not worth its cost, but contending that the balm of increased valuation which time *might* produce would eventually offset the outlay. I have heard individuals strenuously insist on the making of certain improvements for the reason that their communities would be largely benefited, and after such improvements had been completed and the assessments levied therefor, I have listened to equally strenuous arguments from the same gentlemen in an effort to convince the authorities that the benefits derived were largely general and that the city at large should assume the whole or greater part of the cost.

Cases have come to my knowledge where petitions comprehended improvements in localities not only very sparsely settled, but where the property was of such little monetary value as to be practically worthless, where the pro rate of cost of improvement would be about four fold in excess of the value of the property and where any accruing benefit to the city would be so greatly remote and prospective that even a superficial examination of the case would warrant a conclusion that the interested property owners desired to gamble at the city's expense and with the city's resources. If the improvement produced exceptional results their gamble would be successful; contrariwise, their stake was a bagatelle.

It is safe to conclude that occassionally all municipal governments have somewhat similar experiences, but incidents such as these should not have a deterring effect in the exercising of a fairly liberal public policy toward property owners. Every improvement contemplated, not only benefits the private owner but adds just so much to the betterment of the city, as a city, and the question resolves itself into this: Under what circumstances and to what extent should the city extend financial aid?

While it is obvious that no inflexible rule can be established by the officers of a city government in the establishing a maximum per cent. of cost to be borne by the city at large, it is likewise obvious that in the removal of eyesores, in the correction of evils which for a long time have asserted themselves, and in the doing of a work which is part of and necessary to a whole, and which would be impossible of accomplishment without municipal aid, a greater ratio of liberality should be extended.

Up to the year 1895, the improvement laws of the city of Jersey City were cumbersome and the expense incident to the making of an improvement was considerable of a factor in the total cost, the natural results being that comparatively few improvements were petitioned for. With the securing of new and more liberal laws, an appreciable reduction in the expenses theretofore incident, and the pursuance of a more liberal policy toward property owners, more has been accomplished in our city during the past five years than is the sum total of the showing for the twenty years preceding, while the percentage of payment for assessments levied has kept pace with our expectations. Not 1 per cent of the property owners assessed have complained of unequal or excessive assessment and as the result of the policy established, the city has been vastly improved and beautified; her ratables appreciably increased, and her ability to hold her own with the advanced and advancing cities of America rendered indisputable.

A liberal policy, however, cannot be successfully maintained without the exercise of great care, exceeding watchfulness and sound judgment. Officials must be deaf to every claim for partial exemption where the city does not receive an offsetting compensation; blind to every insistment for special favor in which there is nothing of benefit for the municipality; resistant to every demand for something of questionable utility, else that which would otherwise prove a blessing to a community, must result in the discontent of the taxpayers, in a corresponding lack of general interest, in loss of local pride and in the building of a monument of debt, to reduce which processes of law must be largely resorted to.

THE PRESIDENT: I am exceedingly glad that Mr. Bouton has taken up this subject of assessment for local improvements.

The reports of the Committee on Taxation and Assessment have been, for the past two years, confined entirely to the subject of general or special taxation, but have not treated of assessments for local improvements; and I am sure there is no one subject which is a more vexed one and which causes municipal officers more trouble. Opposition to such assessments is commonly caused by selfishness and the fear that some other property owner on another street will get a little more for his money than the objector, and they cause endless trouble and dissatisfaction.

I am sure we will be very glad to hear from any gentleman present on this subject.

MR. BERNARD SAUNDERS: Do I understand from that paper that the officials have to settle the questions of exemptions.

MR. BOUTON: Yes.

MR. SAUNDERS: With us the law fixes that.

MR. BOUTON: In our city the officials determine whether all or a portion of the cost of an improvement shall be assessed or borne by the city at large.

MR. SAUNDERS: Exemptions on local improvements in Ontario are settled by law. The City Engineer or other official has nothing whatever to do with settling the question of exemptions.

MR. BOUTON: I am not speaking from a city engineer's standpoint further than to certify the cost to the proper officials. Our City Engineer has nothing to do with the matter.

MR. DRAKE: I would like to ask Mr. Bouton if it is not the municipal legislative body that has the right to determine what amount has to be placed in general fund and what in local fund?

MR. BOUTON: Yes.

MR. DRAKE: It is not the individual but the legislative body.

THE PRESIDENT: Under the present charter of the Greater New York the Board of Public Improvements and Municipal Assembly have the power to determine, in the case of every local improvement, what portion, if any, of the expense of the improvement shall be borne by the city at large. I have always thought it was a somewhat dangerous provision.

MR. SAUNDERS: That is where the "pull" comes in.

THE PRESIDENT: If there is any one thing more desirable than another in apportionng these expenses, it is consistency; and consistency is an impossibility where every one of these questions has to be decided separately.

MR. DRAKE: The Board of Control recommends it and the Assembly decides it.

MR. VAN DUYNE: The city of Newark and the city of Jersey City are the two first-class cities in New Jersey, and they are supposed to be working under general laws, each being governed the same; but each was under a charter before, and a variety of amendments have been passed, so that they are not working exactly under the same laws. The one matter that I wanted to bring to the attention of the Convention is this, that down to perhaps fifteen or eighteen years ago every cent of outlay for any public improvement—such as opening a street, paving a street, sewering, and so on—was assessed upon the property benefited in proportion to the benefit; the assumption being that no improvement would be undertaken that was not of benefit equal to its cost to the property. There came a time in the history of Newark when a great deal of street opening was undertaken, and the so-called benefit assessments, in a number of cases, equaled or exceeded the value of the property that was assessed; and finally a decision came from the court that the assessment must be for the peculiar benefit. Since that, so far as Newark is concerned, the Board of Works has power to order any work done, but the assessing on the property goes to an independent commission entirely, and the members of that commission are sworn to assess first the peculiar benefits on the property benefited. If there is a balance it is placed in the next year's levy, and so paid by the whole city. The result has been in our paving, which we have been carrying on quite extensively during the last four or five years, that about 75 per cent. of the cosi has been assessed on the property fronting on the street paved for the pavement, and the other 25 per cent. has been assessed on and paid by the city at large.

THE PRESIDENT: The question of what is the benefit, then, is left entirely to their judgment—it is a matter of individual judgment.

MR. VAN DUYNE: Yes. They are supposed to be expert and to make the matter a study, and there is no appeal from their judgment as long as they follow legal principles. They report to the court, and the court does not question their judgment of the amount of benefit; but if there is any wrong principle or any mistake or misunderstanding that can be brought out, it may be referred back, but the court does not attempt to determine the amount—that must be finally determined by judgment of the Commission.

MR. BOUTON: I might say, generally, that for a period of ten years last past no claim of illegality or of inequality in assessment has been sustained by our courts.

THE PRESIDENT: Is there any further discussion on this paper? If not, there is a paper that was on the schedule for this morning and was postponed to this evening's session. I refer to the paper by Mr. Eldridge on "Some Experiences with Portland Cements."

MR. W. K. ELDRIDGE, City Engineer, Lafayette, Ind., read paper No. 18, as follows:

SOME EXPERIENCES WITH PORTLAND CEMENTS.

BY W. K. ELDRIDGE, CITY ENGINEER, LAFAYETTE, IND.

The demand for Portland cements in all classes of work having been greater than the supply for several years past, has almost irresistibly tempted manufacturers to make premature shipments, adulterations, and otherwise to issue defective goods, thereby placing an added burden and anxiety on the conscientious engineer in his endeavors to prevent the use of unseasoned and otherwise unsuitable cements, particularly in the construction of cement sidewalks. This he attempts by subjecting the cement before using to the usual tests now universally prescribed in all satisfactory specifications; but my experience of the past two seasons has indicated that the present method of conducting cement tests does not afford the engineer all the information he should obtain before an acceptance of the cement. Even if he takes the ill-spared time from his other duties to make a determination of the relative proportions of lime, silica and alumina, he would probably get no information of other possible ingredients of an injurious nature, and be left as helpless as before.

Our tests as heretofore made are the usual ones for fineness, time of setting, constancy of volume and tensile strength; but it is easy to reason from a comparison of a number of results, including the action of the work after construction, that such tests may be and I believe are at times more or less deceptive and insufficient for perfect safety.

For instance, it is becoming customary for manufacturers to give artificial age to their cements by adding certain quantities of sulphate of lime. It has long been known that an excess of the sulphate is injurious to the cement, besides concealing certain actions that a test should be permitted to develop if it is to be reliable; but the temptation to go to excess in order to send out a product that will pass the usual tests without waiting for the proper age, or requiring the extreme care necessary in its manufacture, is evidently yielded to in many cases; our experience having fully shown that an honestly made cement not sufficiently aged will fail under the steam or boiling water test, thus betraying its immaturity, while a reinforced cement, though equally green, will pass all the tests that so far are customary.

Any cement containing more hydrate of lime than is necessary for combination with the silica to form the tri-silicate of lime, runs the danger, in proportion to the excess, of the conversion of the free lime into the carbonate of lime, which action causes the cracking and seaming so common in cement walks. The boiling water test is intended to show this in a few hours, while it would require a long period of time otherwise. But since the presence of sulphate of lime will enable the cement to "boil" safely (and the greater the amount the surer it will "boil"), and further retards the action of the free lime in the work, sometimes to a late day, all value in this test is wholly lost when applied to "doctored" cements.

Another inducement for the manufacturer to use sulphate of lime in dangerous quantities, comes from the present demand for very finely ground, slow-setting cements; and as fine grinding hastens setting, a corrective must be applied, and if carried to excess, future disintegration is sure to occur, and the usual tests afford no warning. A demand for high initial strength is also called for in connection with slowness of setting, and these two qualities are also hostile; but since the immediate damaging effects of an excess of lime necessary to produce this high initial strength are concealed by the addition of sulphate of lime, we have a cement, finely ground, slow setting, of high tensile strength, but very dangerous to use.

Having drawn a sample of a certain cement which failed under the boiling water test, I had the experiment made of aging the cement artificially, using different proportions of sulphate of lime in regular progression until the cement would endure the test. No tests were made to determine whether the cement was over-limed or simply too new; nor was any determination made of any sulphate that might have been in the cement before making our additions. When more time permits we expect to go into this part of the matter more deeply. The following table shows the results of this experiment:

Percentage of sulphate added	0	½	1	2	3	4
Setting time under 1 ft. 1-24 in. wire (minutes	7	48	94	135	150	180
Test in boiling water	0	½	1	2	3	4
	Failed under 1 hr.	Failed in 1 hr.	Failed in 1½ hrs.	Whole at 8 hrs. but suspicious.	Whole at 8 hrs.	Whole at 8 hrs.
Tensile strength (neat) in 7 days	330	340	340	510	610	480

It was noticed that the cement required more water for gauging as the per cent. of sulphate was greater.

Summarizing the results of the experiment, it shows that the time of setting is retarded quite uniformly with the progressive increase of sulphate, and also that the capacity of resistance to the effects of boiling water was strengthened in the same manner.

So we find that in this particular case the addition of 3 per cent of sulphate of lime made the cement acceptable according to the prescribed standard of tests. If the cement then were accepted and used, it may be subject to one of three causes for disintegration. If too new, or if over-limed, or if under-burnt, in either case the damaging effect of the free lime is only suspended, its time of action only retarded. If carbonate of lime had been added instead, the effects are the same, except that the disruptive elements in the cement may not show thmselves for a year or more after being used, so slow is their development.

The detection of overlimed cements is often attempted by taking the increase in temperature during setting. This is a certain test provided the cement has not been "doctored," when the test fails, and the effect of the over-liming is retarded for weeks or perhaps months, but is almost sure to make the finished work unsound. In one case, where the temperature rose 23° in 5 minutes, the addition of only 2 per cent. of the sulphate so changed the action that the rise in temperature was only 1° in 15 minutes.

It seems then certain that under present conditions of manufacture the rise in temperature and boiling water tests do not insure a sound cement.

Again, the tests for tensile strength show the progressive action of the sulphate of lime in imparting what may prove to be a meretricious strength to the cement, with a corresponding deception to the user.

In all the voluminous literature on cement, references to this branch of the subject are meager and unsatisfactory, some of them being positively erroneous. For instance, in a book on engineering construction by a well-known engineer of reputation, and much used as a text book, the statement is made that sulphate of lime quickens the setting time of cements. The theory that plaster of Paris, being a quick-setting material, imparts this property to what it is mixed with, seems plausible, but is denied by experiment. Why this is true seems so far to be unknown. The conclusion is also indicated that an unusually high tensile strength at an early period is a suspicious rather than a meritorious circumstance.

In this connection, however, it should be remembered that almost all investigations in connection with cements have been and are being made by chemists in the employ of various cement manufacturing companies, and the information gained by each is carefully guarded by their employers as part of their stock in trade, not to be imparted to their rivals or customers. The benefits of the impartial and independent investigations of the properties of the constituents of asphalt pavements, as carried on by the city laboratories of Washington, Brooklyn and others, are well known and appreciated by the members of this society, and similar work and publications from the same sources on cements would be equally valuable. The competition among manufacturers to produce cements of high tensile strength has, I believe, deceived engineers into raising their requirements to correspond, until the danger line has been passed. One city has been raising the standard each year for a number of years, and parades this before the word as a virtue; but the manufacturer simply winks the other eye and produces a cement to correspond. The composition of cements and method of production are not now so different from ten years ago that a cement honestly and naturally made from the same rock and clay as then will show double the tensile strength legitimately.

Authorities, what few there are, are much at variance about the amount of sulphate of lime permissable in Portland cements before injury is worked, one insisting on a limit of 1½ per cent, while another claims that 8 per cent is allowable, with various other opinions in between, until the practicing engineer feels pretty much at sea in the matter. He is probably safe in adopting the minimum requirement, but with the risk of ruling out many good cements which overstep that limit, for it is possible that a safe amount in one cement might be injurious to another. But the worst feature is in the capacity of the sulphate to conceal bad qualities in cements totally disconnected with the sulphate itself. The question that confronts him is, where shall he take his stand, and what can he do to protect himself and his work? What benefit is it for him to undertake a tedious and possibly expensive quantitative analysis of each sample, if a permissable limit can not be decided upon, beyond which rejection shall be obligatory? It might be suggested that the maximum proportion of sulphate of lime allowed should not be so great as to prevent "blowing" under the boiling water test, if the cement be so constituted as to fail under this test. This rule would seem to place the limit at about 2 per cent., and it might well be less.

If it would be possible to decide this point, and then prescribe one or more tests that would be adequate, easily performed and inexpensive, certainly a great stride forward would be made toward insuring good work of reliable duration. But as the matter now stands, such tests as it is now customary to prescribe in specifications, fail to assure the engineer sufficient guaranty that his work will endure the test of time and the elements.

The idea of a rough and ready test for sulphate and carbonate of lime has taken form out of some of our laboratory experiments, and may briefly be stated as follows:

After first trying the boiling test, (for if the cement fail under this, it is rejected by the terms of the specifications anyway.) dissolve a portion of the sample in dilute hydro-chloric acid, when if carbonate of lime be present, a strong effervescence of carbonic acid gas will take place; and as the carbonate should never be present in any good cement, sufficient grounds for rejection are found at once. The solution should be perfect; though it need not be absolutely clear; and if there be a residue on the bottom of the glass, there is a strong suspicion of adulteration. If, however, nothing suspicious be found so far, the solution may be filtered and boiled, and a small quantity of barium chloride added, which will, if sulphate of lime be present, cause a precipitate which can be taken as a measure of the sulphate for comparative purposes. In order to have a standard for comparison, let a competent chemist take a sample of cement known to be reliable, and accurately determine the percentage of calcic sulphate, if any, and then add enough to bring it up to the allowable limit, and 2 per cent. Then the quantity of the precipitate under barium chloride, may be preserved by sealing the beaker; and if all future tests are made with the same quantity by weight of cement in the same size of beaker, a visual comparison can be made with the prepared standard close enough for practical purposes. But there is another danger attending the use of Portland cements as now made, owing to their adulteration with slag cements, or possibly ground slag itself. A great and growing industry in this country as well as in others is the manufacture of cements from blast furnace slags, going under the name of "Portland" cements. Blast furnace slag being a waste product, its use for such a purpose renders possible the making of a cheaper cement, which, if as good as the regular make, should not be kept out of use. And yet, for sidewalk purposes, any engineer having experimented with this material will not consent to take any more of it in sidewalks. At the same time, it has its legitimate uses, and when submitted to the regulation tests, it rarely fails to fulfill all the standard requirements, and a contractor standing squarely on his rights and dignity can compel you to let him use it. So far this season I have barred it out of sidewalks by insisting that it is not a true Portland cement, but with the expectation some day of having my ruling contested and beaten. There are some slag cement walks which appear good and durable, and of a certain brand, the manufacturer explaining that he puts the slag through a roasting process before mixing and grinding; but I fear that the engineer who accepts even this cement too trustingly would lay himself liable to a roasting also. But if there be any distinction between slag cements for sidewalk use, there is certainly so far no prescribed test by which this distinction can be determined. Ground basic slags are so unstable in their composition, that they have to be kept tightly corked in the laboratory to hold them from the continuous disintegration which goes on during exposure to the air. In underground work, such as street and other foundations, slag cements seem to give good results and cheapen cost; but in the case of sidewalks, a granulating and rubbing off of the surface seems to be continually going on; as in some cases now under my observation, which can not I believe be attributed solely to the traffic. There are so many different constituents in slags, and so many variations in their relative proportions in different slags, that a uniform and reliable product for such extreme service as sidewalk use can hardly be expected.

It is only occasionally that ores and fluxes employed in blast furnaces will produce slag suitable for cement. Also, all such slags are devoid of hydraulic properties unless a change in their composition be effected.

A common use for slag cements which our experiments are pointing to is as an adulterant for regular made Portland cement by which the cost of production may be cheapened and output increased when demands are pressing. This was first noticed in some of the German cements, from which quite an appreciable amount of finely comminuted metallic iron or steel may be extracted by a common magnet, and the same thing was more recently found in two brands of American made cement, amounting, even by this rough and ready method of analysis, to about one part in 1,000 It may be that the particles of metal themselves are not injurious except to the pocket, the purchaser buying one barrel of useless metal and 999 barrels of cement; but if such a complex and mysterious substance as basic slag be present, the risk remains of some one or more of its elements affecting a structure such as a sidewalk exposed to all the effects of heat, cold, water, frost, etc. A sample of acknowledged slag cement showed one part in about 300 of metallic iron, so that the possibility remains of a Portland cement being adulterated with about 30 per cent. of slag, and yet pass all the customary tests and under the usual specifications would have to be accepted.

A statement of the foregoing was sent to a prominent New York engineering periodical, whose editor gravely advanced the explanation that the presence of iron could be accounted for by the wear of machinery. But since many cement plants produce 1,000 barrels per day, any set of machinery that can make a daily contribution of 400 pounds of its substance to its product must, like the widow's cruse of oil, have the miraculous faculty of self-restoration between days.

A series of simple tests for basic slag adulteration may be carried on by anyone with slight chemical knowledge and little paraphernalia. The presence of metallic steel is a sure indication, as no such particles should be present in an honestly made cement. Shake a little of the suspected cement in a glass of water, and stir with a bar magnet of fair strength. On examination, the pole of the magnet will be found more or less covered with minute sparkling particles of steel or iron, easily distinguishable under an ordinary pocket magnifying glass, and there will also be seen minute balls or agglomerations of magnetic material of a nondescript character, which nothing but slag ever contains. If a solution of the cement with hydro-chloric acid be made, there will usually be some insoluble residue; also, a strong odor of sulphuretted hydrogen, betraying compounds of sulphur of a possibly dangerous character when exposed to the air; carbonate of lime, as betrayed by effervescence, may be present or absent. The presence of phosphorus, another element of basic slag, may be ascertained by the molybdate method as laid down in the publications of the official agricultural chemists, and noting a yellow precipitation.*

---

*Bulletin 46—Chem. Div. U. S. Dept. Agriculture.

We have one sidewalk laid about 15 months ago, using a German Portland cement of high reputation and corresponding price, besides sustaining a high physical test, which lasted about ten months before showing signs of cracking, and is now in an active stage of progressive disintegration. Securing some fragments of the top course, I had the foregoing tests made for slag, and in spite of the admixture with sand which had been made in laying the walk, all the characteristic reactions were obtained except the odor of sulphuretted hydrogen, which might be accounted for by the total change of the sulphides in that length of time. On crushing the mixture and testing with the magnet, we were still able to extract bright metallic steel, though much of what was originally there had evidently been oxidized. Carbonate of lime was present in force, also the sulphate of lime, and phosphoric acid. In fact, if we had continued farther, we should doubtless have found that if there were anything in the world that ought not to be in cement, it would be found in that cement. It has been said that the Germans waste nothing; if their slag is high in phosphorus, they make a fertilizer; that which is low in phosphorus they use in cements.

However the doctors like it, there is very little satisfaction to an engineer in holding a post mortem; but the result of this one on the defunct sidewalk in question might be stated in this form:

Dissolution caused by excess of free lime contributed by basic slag adulteration but concealed and true prognosis prevented by the presence of calcic sulphate, complicated with ferric oxide, various sulphides, phosphorus, and other undiscovered components of blast furnace slag.

It is no doubt a legitimate business to engage in the manufacture of slag cements; but to use the same as an adulterant is false and fraudulent, and full of danger to the user in his work.

So far, the season has been too busy to afford much time to be spent on these matters; but a collection has been made of various samples, briquettes of different ages, etc., and we hope that much information may result from more thorough and leisurely examinations that will be of much benefit to the controllers of public works, and develop methods for practical use which will supplement the present standard of tests in the direction in which this standard now fails. But it will be, I believe, of greater benefit if this investigation be undertaken by a number of laboratories, totally disconnected from any manufacturing influences, whereby one may supplement another, errors be mutuallv corrected, and the increase of knowledge by the competition of mind with mind be fully obtained.

Until this be done, I think we may all join in the sentiment of a cement expert, who remarked that the more he learned about cements, the less he was willing to swear to.

The paper was received with prolonged applause.

Mr. Eldridge: I must say that since this paper was written these little balls were found to be the magnetic oxide of iron.

Mr. Sherrerd: I think this is a very valuable paper on cements; it contains a lot of matter that can hardly be discussed without looking it over carefully; and as the author stated he is going on with laboratory work, I think it might be well to mention that the Society, or some members of it at least, will be glad to hear the results obtained in the future.

I did not gather from the paper what quantity of these dangerous ingredients the author thought might be in this cement; that is, in how small a quantity they might be allowed to be present without being injurious.

Mr. Eldridge: The quantity of sulphate of lime employed in the experiment shows that 3 per cent. will make the cement stand all the tests; and while the sulphate itself in that proportion might not be a dangerous ingredient as to its presence and action, it is a dangerous ingredient for the reason that it conceals the faulty action of the cement; and this faulty action of the cement will develop afterwards without regard to the presence or absence of the sulphate of lime.

Mr. Sherrerd: You mean the tests as usually applied would give an unnatural strength of the cement. Although the standard might be high, and the cement reach it, still the tests would not give a fair result?

Mr. Eldridge: No, they would not give a fair result.

The President: Are there any other questions to be asked Mr. Eldridge, or is there any more information to be contributed on this subject. If not, we would like to hear the paper by Mr. Rust on the method of paving the spaces occupied by street railway tracks in Toronto.

Mr. Rust, City Engineer of Toronto, read paper on "Pavements Between Street Railway Tracks."

PAVEMENTS BETWEEN STREET RAILWAY TRACKS.

BY C. H. RUST, CITY ENGINEER, TORONTO, CAN.

In 1891 the exclusive privilege of operating the street railways in the city of Toronto, for a period of thirty years, was disposed of to a company, now known as the Toronto Railway Company. The clauses of the agreement, made between the city and the Company, that refer more particularly to this paper, read as follows:

"The purchaser shall maintain the ties, stringers, rails, turn-outs, "curves, etc., in the state of thorough efficiency and to the satisfaction "of the City Engineer, and shall remove, renew or replace the same, as "circumstances may require, and as the City Engineer may direct. When "a street upon which tracks are now laid is to be paved in a permanent "manner, on concrete or other like foundation, then the purchaser shall "remove present tracks and substructures and replace the same, according to the best modern practice, by improved rails, points and substructures of such description as may be determined upon by the City "Engineer, as most suitable for the purpose, and for the comfortable and "safe use of the highway by those using vehicles thereon, and all changes "in the present rails, tracks, and roadbed, construction of new lines, or "additions to present onces, shall be done under the supervision of the "City Engineer and to his satisfaction."

"(A) In the event of the purchaser desiring to make any repairs "or alterations to the ties, stringers, rails, turn-outs, curves, etc., on paved "streets, the purchaser shall repave the portion of the roadway so torn "up at his own expense."

"11. When the purchaser desires or is required to change any existing tracks or substructures for the purpose of operating by electric or "other motive power, approved by the City Engineer and confirmed by "the Council, the city will lay down a permanent pavement in conjunction therewith upon the track allowance (as herein defined) to be occupied by such new tracks and substructures. This shall first apply only "to existing main lines and thereafter to branch lines or extensions of "main lines and branches, as and when the City Engineer may from time "to time recommend and the City Council may direct and require; but "such tracks as are now laid on a permanently formed roadway, must, "when so required as aforesaid, be changed by the purchaser as hereinbefore provided, without any change of roadbed being made, or any "expense occasioned to the city thereby."

Under the terms of the Agreement the Company pay the City Treasurer $1,600 per annum per mile of double track and eight per cent. of the gross receipts. When the receipts exceed one million dollars, ten per cent. is to be paid.

To raise the money for constructing these permanent pavements debentures were issued payable in ten years, and the revenue derived from the mileage and percentage of gross receipts is used to pay interest and sinking fund upon these, the total amount of bonds issued up to the present time being $1,210,776, and the annual payment to provide interest and sinking fund is $149,136. This is at present very nearly the amount received from the Street Railway Company, but as these pavements between the tracks will last for a much longer period than ten years, in a few years there should be a considerable revenue derived from this source.

A great diversity of opinion has arisen as to the meaning of the word "permanent," used in connection with pavements. In 1888 this question was in the High Court of Justice, before Judge Rose, in a case brought by the Corporation of Toronto, against the old Toronto Street Railway Company, and after a considerable litigation it was finally settled, without, however, the Judge giving his opinion as to the meaning of the word "permanent." When the present company obtained their franchise the interpretation of the word was again subject to a great deal of discussion and in 1893 the continuation of the work of changing the rails by the company and the construction of the pavements were postponed from April until August, pending a settlement as to the meaning of this word. The writer has always taken the ground that in this case the word "permanent" refers to pavements with a concrete foundation and this has since been taken as the meaning of the word as mentioned in these clauses. It is a great pity that this word should be so frequently used in connection with pavements. It would certainly be well in future cases to state explicitly what is a permanent pavement.

In compliance with the provisions contained in the previously mentioned clauses, in the spring of 1892, plans and specifications for paving the track allowance on King, Queen, Yonge and other streets were prepared, and on the 28th June, 1892, the Street Railway Company laid down a temporary track on King Street West of Simcoe Street, and the contractor for the pavements commenced work. The work of changing the tracks and constructing permanent pavements on the above streets was carried on continuously until winter set in (with the exception of a week's intermission during the time of the Industrial Exhibition). The amount of track taken up and relaid this season was 29.9 miles. The method then adopted in paving the track allowance is shown on the sketch attached to this paper. The rail adopted by the Company, and approved by the city, was a 6½ inch steel girder rail, weighing seventy pounds to the yard and having a web ⅜ inches in thickness and a base of 4½ inches wide. A slight alteration was afterwards made in the size of the base, making it 5 inches instead of 4½ inches. The rail now weighs about seventy-three pounds to the yard. From experience since gained a heavier section of rail should have been used. The following are the quantities of materials and weights required to build one mile of single track:

114.714 tons of 73 lb. rails per mile.
5.85 tons fish plates, 17 lbs. per pair.
1,800 cedar ties.
1 ton of spikes, ¾ lbs. each.
1 ton of bolts and nuts, 1 lb. each.

The work of constructing these permanent pavements and the laying of new rails was carried on continuously until the work was practically completed in 1894, there being only a few extensions constructed since. In constructing these new pavements the Street Railway Company took up the old rails, tamped the gravel under the ties, put down new rails and lined and levelled them and the paving contractor did the rest of the work.

It may be of some interest to give the amount of work done in each year, the average cost per lineal foot (the width paved being 15 feet for double track), the average rate of progress per day and the different classes of paving material:

1892—29.9 miles single track cost	$322,555.00
1893—26.1 miles single track cost	392,030.00
1894— 9.8 miles single track cost	116,942.61

Average cost per lineal foot of double track for the different classes of pavement, during these years, was:

Asphalt	$5.23
Granite	2.43
Brick	4.21
Cedar Block	3.83

This covers cost of stone or scoria toothing, but where granite was used the contractor was allowed to relay the blocks that were on the street.

Average amount done per day was:

Asphalt	131 lin. ft. double track
Granite	56 lin. ft. double track
Brick	73 lin. ft. double track
Cedar Block	96 lin. ft. double track

In 1894 on McCaul Street the method of construction was slightly altered, in as far as the system of laying the granite or scoria toothing. It was found that when the blocks were laid as headers and stretchers that the water lodged next the block and assisted in destroying the asphalt. To prevent this it was decided to lay scoria blocks, 4 in. by 5 in. by 9 in., parallel to the rail and then lay the asphalt. The practice had been to lay the first six inches of concrete up to the bottom of the rail, then lay the scoria blocks in mortar and finally put in the remainder of the concrete. On this street a change was also made in this respect. The whole of the concrete was put in at once and while still wet scoria blocks were pounded into it and left to consolidate with the concrete before the asphalt was laid down. In any extension constructed since 1895 wooden ties have been dispensed with and steel tie bars, 2 in. by ⅜ in. placed 6 ft. apart are used, the rails being laid on a solid bed of concrete 8 in. in depth by 20 in. wide. This method of construction is much superior to the first type adopted and is largely used in other cities. A sketch is attached showing manner of construction.

After an experience of six years of the different materials used, it is evident that, with the conditions existing in Toronto, asphalt is not a suitable paving material to be used between street railway tracks. After having been down only four years the asphalt commenced to disintegrate. This was at first more noticeable where the asphalt joined the toothing but it was not long before the rest of the material between the rails commenced to wear into holes. This was due probably to the following causes: The lack of proper foundation under the ties, which was shown by the settlement of the rails in several places; the impossibility of properly tamping the asphalt between the toothing, and the constant watering of the asphalt, rendered necessary by the dust caused by the passage of the cars, and also by climatic conditions. Upon King Street, which was the only asphalt pavement laid without toothing, a rut was soon formed, rendering necessary constant repairs. The fact of the lip of the rail not being quite as high as the head and the gauge of the track being 4 ft. 10⅞ in. instead of 4 ft. 8½ in. probably had a great deal to do in forming this rut.

As previously mentioned the first pavements were laid in 1892, and in 1897 it became necessary to commence tearing up the asphalt and replacing it with granite, scoria or brick, depending upon the amount of travel upon the street. By 1900 all the asphalt between the rails will have been replaced by a more permanent material. Up to the present time seven and one-half miles of this work have been done. As these asphalt pavements were guaranteed for five years arrangements were made with the contractors whereby they substituted brick for this asphalt and were paid $1.50 per square yard, but afterwards when the guarantee expired the price paid for substituting scoria for asphalt averaged about $2.40 per square yard. This includes taking up the old asphalt and also 4 in. of concrete. The amount of money spent up to the present time in substituting a more permanent material than asphalt is $137,340.19. In putting in blocks in place of asphalt, the asphalt was first taken off and then the concrete had to be picked out so as to afford room for the blocks, which were bedded on a cushion of sand. Fortunately on most of the streets the concrete was put in between the rails just to a depth of four inches and it was not a very difficult operation to take this out. Granite is no doubt the most durable material to use between street railway tracks but owing to the very strong opposition of the cyclists to this material not so much of it was used as the Department would have liked and scoria blocks, imported from England, were used instead. On streets where there was not a great deal of travel Canadian paving bricks were used. Cement grout was almost entirely used for this work, although some filling was done with paving pitch but cement was found to be the most satisfactory. Owing, however, to the impossibility of stopping street car traffic while this work was in progress, it was very difficult for the filling to become properly set. On King Street, during the past summer, where we were substituting scoria block for the asphalt, a portion of the pavement between the tracks was laid with concrete. It has been down now some two months but not long enough to know the result.

MR. FISHER: The paper by Mr. Rust is an exceedingly interesting and valuable contribution. The relations between the railway company and the city are more favorable to satisfactory work than in most other cities. I have alluded to the conditions existing in Rochester, N. Y., and will now call attention to a few extracts from our specifications relating to permanent pavements in the space occupied by the railway tracks. Two plans are followed:

1. Tie Construction. This method is adopted when a possibility of any settlement exists, as over a new sewer. Wooden ties, spaced two feet center to center, are used.

2. Concrete Foundations Under Rails. No wooden ties are used in this method. Old rails 4½ inches high are used as ties to hold the rails in position and to anchor the track to the concrete beam. These rails are spaced six (6) feet center to center. In some streets every third rail extends across both tracks.

The rail adopted is a full grooved girder rail 9 inches deep for stone pavements, and 6 inches for brick. We do not think it advisable to lay asphalt between the rails. We lay it against the outside rail and prefer this to toothing when the rail has a solid foundation.

THE NEW YORK
PUBLIC LIBRARY.
ASTOR, LENOX AND
TILDEN FOUNDATIONS.

2

p
tl
b
o
o
C
w
n
li
s
w
tl
t
s
d
tl
a
h
tl

e
r
w
e
e
i
l

b
s

u
t
b
I

s
a
o
f

THE NEW YORK
PUBLIC LIBRARY.

[illegible]

EXTRACTS FROM SPECIFICATIONS FOR STREET PAVING—ROCHESTER, N. Y.

In case that portion of a street occupied by the tracks of the street railway company is included in the work to be done by the contractor, the contractor will remove the present pavement from between the rails and tracks, so that the railway company can remove the tracks.

After the removal of the tracks by the railway company, the excavation of the portion of the street occupied by the tracks shall be made ot such depth and width as to allow in the case of wooden tie construction a clear space of 5 inches under 6 inches at the ends of the ties for concrete, the remainder of the excavation shall correspond to that required for the pavement in the remainder of the street.

The railway company will then lay and adjust its tracks to grade. The tracks will be supported on blocking until the concrete is put in.

The contractor shall then clear out any earth that may have fallen into the excavation and proceed to fill the space under, around and top of the ties with concrete made with natural cement or with Portland cement as may be specified. The concrete shall be carefully tamped under and around the ties and the surface left — inches below the top of the finished pavement. This concrete shall be put in at the same time as the concrete under the adjoining pavement, or if not possible to do so, shall be properly connected therewith as directed. The work shall be so done as not to disturb the grade of the tracks and also to afford a uniform support for the tracks. The concrete shall be carefully tamped under the rail between the ties. The railway company will furnish such inspectors and assistants in tamping as they deem necessary.

CONCRETE FOUNDATIONS UNDER RAILS.

In case a concrete foundation with iron ties is specified for the railway tracks, the contractor will remove the present paving, so as to allow the railway company to remove the tracks. The contractor will then make the excavations necessary to allow the concrete foundation, tile drains and gravel filling to be put in.

Under the concrete foundation, about one foot outside of the outside rails of the railway tracks, there is to be laid a three-inch farm tile in coarse gravel, with joints covered with gunny cloth, laid for full length of the improvement and connected with surface sewers or manholes. The depth of this tile shall be two and one-half feet below the grade of the finished pavement.

The tile drain shall be covered with coarse gravel for a width of six inches and to the bottom of the concrete foundation under the asphalt surface.

A coarse gravel foundation sixteen inches wide and four inches thick shall also be placed under the concrete beneath the outer rails of the street railway tracks.

A Portland cement concrete foundation of the dimensions shown on the drawings, mixed in the proportion of one (1) part cement, three (3) parts sand, and six (6) parts stone, shall be constructed for a width of about sixteen feet, in the middle of the street under the block stone pavement and under the tracks of the street railway company.

That portion under the outer rails shall be twelve inches below the base of the rail for a width of sixteen inches under each rail. Under the center rails the depth shall be the same and the width shall average fourteen inches. The remainder shall be six inches. The street railway company will furnish and locate such number of ties, bolts, clamps, or other devices as the City Engineer deems necessary to properly secure the rail, and the contractor shall put in the concrete so as to leave said bolts and clamps in the location and at the elevation prescribed.

The contractor shall also tamp under and around the rails with fine concrete and thoroughly grout the same with grout made of one part Portland cement and two parts clean, sharp, screened sand, so as to make a firm, uniform bearing for the rail.

The street railway company will furnish such inspectors and assistance in tamping as they deem necessary.

The top of the concrete shall be left at a uniform grade of 8 inches below the grade of the finished pavement, for block stone pavement.

The contractor shall fill the space between the flange and head of rail, as shown on plan, with fine concrete or mortar, made of one part Portland cement, 3 parts sand, and 5 parts fine gravel or stone chips.

MR. DRAKE: It might be interesting to know the experience we have had in Buffalo. We found it necessary to replace the asphalt between the tracks with stone pavement; and we are now putting the stone block pavement between the track and toothing outside; the asphalt would not stand the wear and tear of the frost.

MR. SAUNDERS: How do the bicycle men like that?

MR. DRAKE: They do not pay the bills, so we do not allow them to dictate. There is plenty of room outside the rails.

MR. TILLSON: I would like to ask Mr. Rust if this failure of the asphalt between the tracks has occurred at any place where the rails were laid on a concrete beam.

MR. RUST: On Avenue Road, about five years ago, the first street was constructed with concrete beams, and the asphalt is no doubt much better; but I notice that there are now some slight hollows forming. I think that is largely caused by watering, and I think it will be only a few years till that will become disintegrated. Of course, the concrete beam is a much better form of construction, but there is very little travel on Avenue Road—it is a street in the outskirts of the city. Mr. Whinery, I think, can give us something interesting about asphalt.

THE PRESIDENT: We will be very glad to hear Mr. Whinery.

MR. WHINERY: Mr. President, as I said to-day, it is very kind, indeed, to ask me to speak on these subjects; but, without going into detail, I hardly think it would be proper for me to take part in the discussion here, and I shall be very glad indeed if you will excuse me.

MR. FISHER: The practice in Rochester with regard to asphalt pavements in streets having street car tracks is as follows: We pave with medina block stone between the rails and the tracks, and bring the asphalt up to the outside rail. We have no difficulty with the asphalt on what we call permanent foundations for the railroad tracks; but in other streets where the tracks are not laid on a permanent foundation we put in a toothing of medina stone laid in two good courses. By permanent foundation I mean a concrete foundation either directly under the rails or under and around the ties.

THE PRESIDENT: If there is no further discussion on this subject we will pass to the next on the program, which is the report of the Committee on Water Works and Water Supply, by Mr. M. R. Sherrerd, Chairman of the Committee.

MR. M. R. SHERRERD, Engineer and Superintendent Water Department, Newark, N. J., read paper on "Water Works and Water Supply," as follows:

REPORT OF COMMITTEE ON WATER WORKS AND WATER SUPPLY.

To the American Society of Municipal Improvements.

Gentlemen:

Your Committee on Water Works and Water Supply in considering the question of the collection of data for a report, find the field too broad for a detailed analysis, and the intelligent comparison of facts collected from answers to circular letters depends to such a great degree upon a thorough knowledge of local conditions, that we have concluded not to approach the subject in that manner. We, therefore, beg your indulgence in presenting for your consideration, a few phases of the Water Supply question of a general nature.

Among the many subjects let us select at this time the following: Municipal Ownership and the Reduction of Waste.

MUNICIPAL OWNERSHIP.

As regards other public utilities some question as to Municipal Ownership may be raised, but it is almost universally conceded that every city should own its Water Supply, and our society made up as it is of municipal officers, we venture to assert, can hardly conceive of any question being raised on this point.

A municipal corporation certainly ought to be able to save for its city the profits which a private corporation would turn over to its stockholders, and to give its citizens the benefit of a pure Water Supply at the cost of distributing it.

Many of our cities are so situated that the procuring of an adequate Water Supply for their growing needs is becoming a very serious question. Advantage is being taken of this situation in many places by wise financiers, and unfortunately by scheming corporations to forestall the often tardy action of our municipalities, the water rights of available Water Supplies are being procured by these schemers and sometimes unavailable supplies are unloaded upon municipalities by questionable methods—We believe it is well to sound a note of warning and recommend that city officers having charge of the Water departments should consider well the future outlook and urge prompt action to conserve a present supply and provide for that which may be needed.

REDUCTION OF WASTE.

To conserve the supply the reduction of waste is imperative. Almost without exception the reports of Water departments testify to the decrease of the reckless waste of water following the introduction of meters—It will not be out of place to give you the recent experience of the Chairman of this Committee in his endeavor, under the direction of his Board, to reduce the waste of water in Newark, N. J.

In 1898, with 10% of the services metered, the metered takers used 12% of the supply and paid approximately 28% of the revenue. The city for public service—fires and drinking troughs—used approximately 5% of the total quantity, the Water Department receiving an equivalent of 4% of its revenue by taxation, while the quantity chargable to unmetered consumers and waste, amounted to 83% of the water delivered to the reservoirs and paid only 68% of the revenue.

During May of this year the compulsory introduction of meters was undertaken by the city *at its own expense* for the meters and the labor of setting them—A careful house to house inspection embracing a notice to repair leaky fixtures was made. The horse drinking troughs (about forty in number) were provided with float valves set to run slightly to maintain fresh water at all times, but only to run full force when drawn down by use. At this time all factories and a few other places had meters—There being about 3,200 meters out of a total of 32,000 taps or 10% of the services being provided with meters—During May, June, July and August, meters were set at the expense of the Water Department on 3% of the taps, selecting the wasteful consumers (principally saloons, tenement houses and business places).

The result has been a lowering of the consumption nearly 15%—under the daily average consumption, as shown by a comparison with corresponding months in previous years. Expressed in million gallons per day as follows:

	1895.	1896.	1897.	1898.	1899.
July.	21.3	22.9	25.1	28.4	26.3
August.	22.6	23.0	24.6	29.4	25.5

Perhaps one-fifth of the above reduction can be attributed to the special inspection and the change in the watering troughs but by far the greater part is due to the new meters. This corresponds to a reduction of the consumption from 110 to about 95 gallons per capata and during the months of heavy draught.

The larger European cities maintain their water supplies upon the basis of 25 gallons per capata. American cities (and according to report Toronto though English in some respects is American in this) are more lavish in their use of and arrangements for using water, but the experience of cities, even in this country, where a general use of meters obtains, shows that all legitimate use of water and the allowance for unavoidable waste, is amply furnished on the basis of from fifty to sixty gallons per capata per day.

It should not be overlooked that the reduction of the consumption materially increases the pressure and fire service, thereby materially reducing the yearly outlay for increasing the size of feeder mains. The amount of money usually spent on laying larger mains would, if advisedly applied, in most of our cities in the introduction of meters during say a period of five or six years, not only increase the fire service generally throughout the city (not the case with laying a new supply main for one section) but would prolong for that time the available supply or postpone the purchase of new pumps and supply mains.

THE PRESIDENT: The next item on our program is an illustrated talk on a very interesting piece of work which has been for some time in progress in the city of Albany, by Mr. Allen Hazen. Mr. Hazen has come here from New York with his lantern slides to describe this to us. I am sorry that the overflow of business from this afternoon has kept Mr. Hazen waiting so long, and therefore, without further preface, I will give myself the pleasure of introducing to you Mr. Allen Hazen, Consulting Engineer, of New York, and the designing and constructing engineer of the Albany Filtration Plant.

MR. HAZEN: Mr. President and Gentlemen, with your permission I will show a few pictures not covered by the title—some snap shots which I have taken of various filters and works connected with them—and will say a few words in regard to the nature of the filtration, as I judge, from some talk I have heard, that some of the delegates are not familiar with that.

The earliest supply of water of large cities, or of cities, was from wells. These wells, as the population increased, became more and more polluted, and the effect thereof upon the health of the people who used them is not difficult to trace even at this time. Wells were finaly abandoned for river water supplies; not because of their unhealthfulness, which was not even then recognized, but because enough water could not be secured from them. When river waters were substituted for well water supplies they differed in their physical characteristics very strongly. The well waters had been clear and colorless; the river waters were muddy and often colored. Efforts were made almost from the first to remove the impurities from the river waters and obtain waters equivalent in physical properties to well waters, and the earliest efforts at purification were directed exclusively to the appearance of the water. The beginning of modern water purification may be said to date from the year 1829—seventy years ago—when James Simpson constructed for the Chelsea Water Company of London a filter which successfully filtered the water of the Thames. I will now proceed to show you the slides of which I have spoken.

Mr. Hazen then gave a large number of very interesting views, giving a graphic verbal description of each picture as it was cast on the sheet. (Applause.)

The President: I am sure we have all enjoyed Mr. Hazen's talk very much on this interesting work. Are there any questions which the members would like to ask him? I would like myself to ask Mr. Hazen how long it is after the filter is put in operation, or clean sand is put on, before it is necessary to remove the sand for cleaning.

Mr. Hazen: We expect to take off about half to three-quarters of an inch at a time, perhaps once in a month on an average, which will be twelve times a year, say eight inches a year; and after a year perhaps we will replace the sand which has been washed, bringing the flow of the filter back to its original level. The sand is sufficiently deep to allow for a foot or more to be taken off before it is replaced without any danger to the purity of the supply.

Mr. Thompson: Mr. Hazen has put himself to considerable trouble and inconvenience in giving this talk to the association, and I would therefore move that the association offer Mr. Hazen a vote of thanks for his interesting talk.

A Member: I will second that motion.

The President: It has been moved and seconded that the Society offer Mr. Hazen a vote of thanks for his kindness in giving us this talk to-night. I take great pleasure in putting the motion.

The President put the motion, and, on a vote having been taken, declared it carried, and tendered the thanks of the Society to Mr. Hazen.

MR. AMES: I had a question last night to ask, but did not ask it; I want to ask it now.

Mr. Benzenberg, in speaking about Milwaukee, said that they made very little allowance for pipe leakage. I would like to ask what the pipe leakage is likely to amount to in a water works system.

THE PRESIDENT: Do you mean an old or a new system?

MR. AMES: I would like to have some idea as to what that may amount to in the different systems. The reason I ask this question is that I went to our reservoir and stand-pipe last fall with the idea of determining the amount of waste that might be going on. We had the pumps stopped—it was between the hours of midnight and 2 or 3 o'clock in the morning, so that there should be very little legitimate consumption—and the result of our measurement was that the water was leaking in the system at the rate of about 8,000,000 gallons per day; the amount of water being pumped, according to the pump counters, was about 14,000,000 gallons. I wondered if there would be a large proportion of that waste that would be due to pipe leakage.

THE PRESIDENT: Can anybody give Mr. Ames any information as to the leakage from mains in different cities?

MR. SHERRERD: The question came up for consideration recently in New York city, and it was variously estimated at from 15 to 60 per cent. of the supply, depending considerably upon the age of the system. In my opinion,it is certainly of enough importance to water works that the distribution systems of our different cities should be divided into sections, and meters located on the main feeders in the different sections in such a manner as to enable an engineer to determine exactly as to the waste, in order that large leaks may be discovered.

THE PRESIDENT: I believe the system in which that occurred was fifty-six or fifty-seven years old, and such waste is supposed to increase quite rapidly with age.

MR. SHERRERD: Do you mean in lower New York?

THE PRESIDENT: Yes, in lower New York.

MR. SHERRERD: I have heard that statement; but I have heard people who worked on the main in the city say that the pipe is extremely tough and that the question of age does not appear to bear that proportion to the leakage which it has been made to appear to do. It was said the pipe that supplied lower New York was so old that the leakage was very great. I believe you refer to that, Mr. President.

THE PRESIDENT: Yes.

MR. SHERRERD: I believe it was estimated at from 15 to 60 per cent.

MR. AMES: I am going a little farther. The water pipe system at present in Grand Rapids is not very old. We had at one time about twenty miles of Wykoff pipe. That pipe in its later years used to split frequently but it would always show on the surface of the ground where the split was, so that when we came to replace the wooden pipe with iron the superintendent did not consider it essential to test the joints by pressure before covering, because of the fact that the leaks had always shown themselves previously; so, very little of it has been tested. We have begun testing our pipe this fall, and the third piece of pipe that was tested leaked. In putting the meter on the pipe to determine the amount of leakage going on in a quarter of a mile of pipe, we found there was about five cubic feet an hour, and yet it did not show up on the surface of the ground at all and with the small pump he was testing with it was impossible to get it to the surface with a 60-pound pressure.

MR. SHERRERD: I should have added, with regard to the New York system, that one cause of the large leakage there that is undetermined is due to the large dock frontage in the old part of the city, the entire lower part of the city being surrounded by water. Any leaks occurring can not easily be found, and are, no doubt, allowed to run for long periods without detection.

MR. BENZENBERG: It seems to me that when indications show that there is a large leakage, it is well to look for some other source than leakage through pipe joints. If you will estimate the amount of water that is likely to leak at a pipe joint, and the number of such leaks necessary to make or represent 8,000,000 gallons of water a day, you will soon come to the conviction that that amount of water is not likely to leak through pipe joints unless the openings are very large, when the water will be forced through in such volume as to indicate itself upon the surface—unless there be a direct connection with the sewers.

I think some experiments and tests were made in some of the cities in New England, where nearly all of the services had been metered; and the entire supply through the distribution system was also metered, and in that manner perhaps the most accurate determination could be arrived at—more so, certainly, than in any other way, the water being metered at both the inlet and the numerous outlets. If I am not mistaken, in two cases, the wastage was considered in one instance at 16 per cent. as abnormally high, sufficient to warrant an investigation. I cannot speak from memory now to the exact percentage, nor of the location; but I remember reading a report in the proceedings of the New England Water Works Association, and also in a report of the town that was mentioned. But when you come to 50 per cent. or more, or even 25 per cent., it seems to me that then you are representing percentage of leakage of so large a quantity of water that it will not pass through the joints without indicating itself either on the surface or in the drains.

Mr. Ames: Mr. President, I did not mean to convey the idea that that 8,000,000 gallons was due to pipe leakage. We know there was a large amount of water being wasted through hopper closets. But what I was anxious to know was if 5, 10 or 15 per cent. or 20 per cent. would be possible to leak from the pipe system, how much of that to properly charge to pipe leakage and how much was to be looked for in the fixtures.

The President: If there is no further discussion, the report of the Committee on election of officers and next place of meeting will be in order; but before receiving their report, I wish to make announcement. Yesterday the President was authorized to nominate a committee of five to confer with the Superintendent of the Census concerning the practicability of collecting information on municipal data and making it part of the Federal Census, and in conformity with that resolution I will name as that Committee Messrs. Herrmann, Thompson, C. C. Brown, Dr. Woodward and M. R. Sherrerd.

We will now be glad to hear the report from the Committee selected yesterday for the nomination of officers to be elected for the ensuing year, of which Committee Mr. Benzenberg is the Chairman.

MR. O'BRIEN: Before that is received I would like to present the report of the Finance Committee.

THE PRESIDENT: We will be always glad to hear from the Finance Committee.

REPORT OF THE FINANCE COMMITTEE.

MR. O'BRIEN read report of the Finance Committee, as follows:

TO THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.

GENTLEMEN:

Your Committee on Finance would report that they have examined the report of the Treasurer, checked up the receipts and vouchers for disbursments, and find the same correct.

There has been collected from all sources during the past year, the sum of $1,033.25, total disbursments $975.20, leaving a balance on hand of $84.77.

Respectfully submitted,

F. I. O'BRIEN,
Chairman Committee.

MR. O'BRIEN: This is the fourth report I have signed, and it is the first one in which we have shown a balance on hand, and for that balance we owe our thanks to the President; it is due to the President.

MR. HERRMANN: Mr. President, I desire to present the report of the Executive Committee.

REPORT OF EXECUTIVE COMMITTEE.

Toronto, Can., Oct. 4th, 1899.

To the Members of the American Society of Municipal Improvements:

Gentlemen:

Your Executive Committee after examining the reports of the Secretary, Treasurer and Finance Committee, desires to congratulate the Society upon the fact, that for the first time since its organization, is it able to state, that all of its obligations have been liquidated, and there remains a cash balance in the treasury to-day. In order to regulate the manner of distribution for publication of the papers submitted to the Society, your Committee recommends that the following be adopted as a by-law of the Association:

BY-LAWS.

No. 1. Members shall not be permitted to give out for publication, any papers to be submitted to the Society at its annual meetings, in advance of such meetings, and all requests for papers for such purpose shall be referred to the Secretary.

No. 2. All committees and members of the Society, shall be required to furnish four copies of all reports, papers or other matters submitted to the Society for its consideration. Your Committee is of the opinion that some decisive steps should be taken to not only increase the membership of the Society, but to maintain its present membership as well, and to secure representation at future meetings from those cities which have acquired a membership in the past, although not represented by officials at present. For that reason we recommend the adoption of the following by-law:

No. 3. It shall be the duty of the President on or before the 1st of January of each year, to divide America by States into Territorial sections, and to assign one or more members of the Executive Committee to each of said sections. It shall be the duty of the members of the Executive Committee thus assigned, to keep an accurate list of the municipalities and members of the Society in the particular territory assigned to them; and to ascertain from time to time, whether or not the members of the Society from the territory assigned to them, are still municipal officers; and when not, to take such steps as may be necessary to secure new members from such municipalities, as well as to secure membership in the Society of such municipalities and officials in the territory assigned to them that have not acquired the same in the past. Your Committee also recommends that they be authorized to prepare for publication and distribution, a brief history of the Society, and what it has accomplished, and print 1,000 copies of the same in pamphlet form of not exceeding twenty-four pages, the same to be distributed by them not later than August 1st, 1900, to municipalities and officials not now members of the Society, with an invitation or request to become members and attend the next annual meeting.

Your Committee also recommends the adoption of the following by-law:

No. 4. The President shall be required at least 60 days before the holding of the Annual Conventions; to communicate with the local Committee having charge of the arrangements of the Convention, in the city in which the same is to be held, with a view of securing exact data as to place of meeting, entertainment to be furnished, hotel and railroad rates, etc.; and to print this information together with such data relating to the business of the Convention as he may have, and turn the same over to the Secretary or members of the Executive Committee for distribution.

All of which is respectfully submitted,

G. H. BENZENBERG,
AUG. HERRMANN,
NELSON P. LEWIS,
HARRISON VAN DUYNE,
D. L. FULTON,
A. D. THOMPSON,

THE PRESIDENT: You have heard the report of the Executive Committee; it reports the adoption of several by-laws. What is your pleasure?

MR. TILLSON: I move that it be adopted.

MR. DRAKE: I second that motion.

MR. ADAM: I believe the President of the Society made the suggestion that the Society should take some action in regard to the advisability of obtaining copyrights on the papers presented and read before the Society, so that they should not be published broadcast by any paper in the States.

THE PRESIDENT: That has been discussed at the meeting of the Executive Committee, and the decision was that it would be unwise to take such action at the present time.

MR. ADAM: I did not know such action was taken, because the Committee has not made a report on it.

THE PRESIDENT: It was not referred to the Committee; it was merely a suggestion of mine that was discussed.

MR. SHERRERD: Does the adoption of the report mean the adoption of the by-laws, or must we vote on those separately.

MR. TILLSON: Have we not got to adopt the report first and deal with the by-laws in separate motion?

THE PRESIDENT: I think Mr. Tillson's point is well taken.

THE PRESIDENT put the motion, and, on a vote having been taken, declared it carried.

MR. O'BRIEN: I move that the by-laws as recommended by the Executive Committee be adopted.

MR. TILLSON: I second that motion.

THE PRESIDENT put the motion, and, on a vote having been taken, declared it carried.

MR. THOMPSON: There is another matter which I believe should be called to the attention of the Executive Committee. There have been several requests from gentlemen who are not connected with city positions in any manner for admission to the Society, and under the Constitution they cannot be properly admitted. I think the Executive Committee should consider an amendment to the Constitution, so that these gentlemen who are desirable can be admitted upon vote.

I move that the Executive Committee be instructed to consider the advisability of presenting an amendment to the Constitution which will permit men not directly connected with municipal works, but who are in sympathy with that line of work, to become members of the Society.

MR. RUST: I will second the motion.

THE PRESIDENT: It has been moved and seconded that the Executive Committee of the Society be instructed to take into consideration the advisability of presenting an amendment to the Constitution which will permit men not in the employ of any municipality, but connected in some way with municipal work, to become members of the Society. Carried.

REPORT OF COMMITTEE ON NOMINATION OF OFFICERS FOR THE ENSUING YEAR.

MR. BENZENBERG: Mr. President, the Committee on nominations has had several meetings, and I am instructed to report the following recommendations for the various offices to be filled

President	Mr. A. D. Thompson, Peoria, Ill.
First Vice President	Mr. Robert E. McMath, St. Louis, Mo.
Second Vice President	Mr. Bernard Saunders, Toronto, Canada.
Third Vice President	Dr. William C. Woodward, Washington, D. C.
Secretary	Mr. D. L. Fulton, Allegheny, Pa.
Treasurer	Mr. F. J. O'Brien, Oswego, N. Y.

FINANCE COMMITTEE.

Messrs. Will B. Howe, Concord, N. H.; Joseph Emmer, Grand Rapids, Mich.; William S. Cook, New Bedford, Mass.

G. H. BENZENBERG,
GEO. H. AMES.
JOSEPH ELDER,
HARRISON VAN DUYNE,
Committee.

MR. ADAM moved, seconded by Mr. Tillson, that the report be reecived.

THE PRESIDENT put the motion, and, on a vote having been taken, declared it carried.

MR. VAN DUYNE moved that the rules be suspended and that the President be requested to cast a ballot in favor of the nominees of the Committee.

MR. TILLSON: I second the motion.

THE PRESIDENT put the motion, and, on a vote having been taken, declared it carried.

THE PRESIDENT: In accordance with the instructions of the Society, I have to report a ballot cast and the following officers unanimously elected:

President, Mr. A. D. Thompson; First Vice-President, Mr. Robert E. McMath; 2nd Vice-President, Mr. Bernard Saunders; 3d Vice-President, Dr. William C. Woodward; Secretary, Mr. D. L. Fulton; Treasurer, Mr. F. J. O'Brien.

Finance Committee: Messrs. Will B. Howe, Joseph Emmer, and William L. Cook.

And I have much pleasure in declaring these gentlemen duly elected the officers of the Society for the ensuing year.

The President's announcement was received with very hearty applause.

REPORT OF COMMITTEE ON SELECTION OF NEXT PLACE OF MEETING.

MR. HERRMANN read report of Committee, as follows:

Toronto, Canada, October 4, 1899.

TO THE MEMBERS OF THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS:

GENTLEMEN:

Your Committee appointed on the 3d inst., for the purpose of selecting a place of meeting for the year 1900, beg leave to report as follows: That we have had under consideration letters from the Mayor of Detroit, Michigan; also from the Mayor, and Citizens' Business League of Milwaukee, Wisconsin, together with a personal request from Messrs. Hannon and Benzenberg of that city; and also a verbal invitation from Mr. Thompson representing the Mayor, Board of Trade, and Merchants and Manufacturers' Association, of Peoria, Illinois. After duly considering these invitations we find that the city of Detroit has never acquired a membership in this Association, and for that reason its invitation should not be considered. Your Committee recommends that the city of Milwaukee, Wisconsin, be chosen as the next meeting place of the Society, and that the Secretary be instructed to notify the Mayor of Detroit, Michigan, of the reason for the action of this Committee in not considering the invitation of that city, and to request him to take the necessary steps to acquire a membership in this Society for his city.

All of which is respectfully submitted,

AUG. HERRMANN, Chairman,
WM. C. WOODWARD,
A. D. THOMPSON,
GEO. M. BALLARD,
E. A. FISHER,
Committee on Selection of Next Place of Meeting.

MR. DRAKE: Before a vote is taken I desire to take up a moment of your time. The legislative body of the city of Buffalo instructed the delegates from that city to extend a cordial invitation to this Society to meet in Buffalo in 1901, believing that the members will all have a particular interest in the city, and assuring you, if you accept the invitation, we shall do the best we know how to make your visit to Buffalo enjoyable. (Applause.)

MR. BENZENBERG: I would like to say a word. It may be hardly necessary to call the attention of the members to the fact that whenever Milwaukee has extended an invitation to any organization, either national or State in its character, it has always redeemed every obligation and pledge that was made in extending that invitation. Generally it has been the opinion that Milwaukee had done more than was promised, and every visitor has always left entertaining the best feeling and cherishing the kindliest recollections of their short stay in the city.

The authorities of Milwaukee will undoubtedly do more towards receiving and entertaining you, and making you feel welcome and at home, than perhaps towards any other organization, because of the nature and objects of this Society and of the benefit that Milwaukee will undoubtedly derive from your deliberations while there.

We have a great deal to show you in the way of municipal improvements and of natural beauty, besides a great many other things that may be of interest to you, though they are not municipal works. I hope that the Society will graciously vote to have its next meeting at Milwaukee, and with that hope I link the promise on our part that if you will come we will do all we can to make you feel that you are welcome, at home, and glad that you have come. (Applause.)

MR. O'BRIEN: I move that the report of the Committee on the next place of meeting be adopted, and that we meet at Milwaukee.

MR. DRAKE: I second that motion.

THE PRESIDENT put the motion, and, on a vote having been taken, declared it carried.

Mr. Benzenberg: Mr. President and Members of the Society, I thank you.

George M. Ballard: In connection with the proposed meeting in Milwaukee next year, I desire to ask if there is any specified time at which we must meet. I ask that question because Mr. Benzenberg stated that probably the pleasantest time for this Society to meet there would be in the middle of September, instead of as late as we are meeting here at the present time. If that is the case we might as well take all these pleasant things in the most pleasant time that we can possibly have them, and I would suggest that we have our meeting in the middle of September instead of on the 3d, 4th and 5th of October.

The President: The Constitution says the meeting of the Society shall be held in the second or third week in October, but it also provides that the members of the Executive Committee, by a vote of three-fifths of the Committee, may change the time of meeting to any time that may to them seem best.

Mr. Ballard: I think then, perhaps, in order to have the expression of the members it would be just as well to take a vote on the proposition that this Society requests the Executive Committee to call our next meeting for some time during the middle of September.

A Member: I second the motion.

The President: It has been moved and seconded that the Society request the Executive Committee to have the Milwaukee meeting at an earlier date (if possible) than the present meeting, preferably about the middle of September, if, of course, there are no local considerations which may interfere.

Mr. Ballard: Certainly.

The President put the motion, and, on a vote having been taken, declared it carried.

The President: I have been requested to announce that the hour at which we are to start to-morrow morning for our coach drive has been deferred to 10 o'clock, at the request of the ladies.

I was asked yesterday whether or not the intention was that the ladies should join in this ride. I felt confident that the Local Committee would never dream of such a thing as not including them, and that confidence has been confirmed—the Local Committee insists that the ladies go with us. We will therefore meet in front of this building at 10 o'clock to-morrow morning. I would also like to say that Mr. F. L. DeCarrie, Mechanical Superintendent of the Montreal Fire Department, says that he will have in front of the building to-morrow one of his appliances for cleaning catch-basins which he will be very glad to show to the members of the Society, and if the members will be here a little early they will have an opportunity to inspect this appliance.

I am also requested to announce that to-morrow afternoon after 1 o'clock the elevator will run to the top of the tower and the members of the Society are invited to take the ride up and get the view of Toronto from the top of this building. It will be well worth the trip.

The Secretary requests me to remind any of you who have railway certificates and have not turned them in to give them to him without delay, as it is expected that the agent of the trunk lines will be here to-morrow and the question of reduced rates for the return trip to your homes will be taken up.

On motion, the meeting adjourned to meet on Thursday, the 5th October, 1899, at 10 o'clock a. m., in front of the building.

THIRD DAY—MORNING.

Thursday, 5th October, 1899, 10 o'clock a. m.

The members of the Society, accompanied by the Reception Committee, took part in a coach drive through the main business and residential portions of the city, visiting, en route, Reservoir Park and the Legislative Assembly buildings.

AFTERNOON SESSION.

Thursday, 5th October, 1899, 2 o'clock p. m.

THE PRESIDENT, Mr. Lewis, called the meeting to order, and said, "We will have to proceed in spite of the fact that many of our members are not present. The first paper is one on the Disposition of Garbage, by Dr. W. C. Woodward."

DR. WOODWARD: In presenting this report I deem it but just to the other members of the Committee to say they have not been able to do anything, and the report is a sort of minority report, although it is a report of the Committee. I communicated with Mr. Rosewater and Mr. Shifferens—I had intended to present the report to them before reading it before the Society—but have not been able to secure a meeting with them.

I submit the report as the Committee's report; but the other members will be relieved from any responsibility as to any of its sentiments.

REPORT OF COMMITTEE ON DISPOSITION OF GARBAGE AND STREET CLEANING.

THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMEMTS.

GENTLEMEN:

Your Committee on the Disposition of Garbage and Street Cleaning has the honor to submit the following report: Endeavoring to carry out the purpose for which it was believed to have been created, rather than to conform to the lines of work indicated by its title, it has extended its inquiries so as to include ashes, miscellaneous refuse, and night-soil, as well as garbage and street sweepings. A summary of the data which has been collected is appended to this report; it may be ot some value as a basis for future investigations, although in its present form it is too incomplete to be of service otherwise.

The most marked feature of the prevailing methods of collecting and disposing of city wastes is the absence of uniformity. So far as can be seen this does not depend upon differences in the form of municipal organization or in municipal needs, but is an indication of the varying stages which the cities have reached in the evolution of complete and perfect systems of collecting and disposing of such material. The progress of such evolution has been rapid during recent years but much time and money has been, and is being, wasted by the duplication of investigations by different cities. Much can be done by the efforts of this organization, which will prevent such waste, if its representatives are properly supported by the officials of the various cities from which they seek information. While many inquiries have been answered promptly, many, we may regret to say, have been ignored, or answered in a perfunctory manner, and as a result the work of your committee has been rendered more difficult. The results accomplished will be more valuable, too, if such of the cities as have membership in this Society will indicate, from time to time, such special data as they desire, so that it can be collected by your Committee and made available to the entire membership.

It appears from inquiries that have been made that in many cities only kitchen waste—garbage or swill—is collected at public expense, and so far as can be judged from such investigations as are being made, generally no extension of the service is contemplated. It is worthy of note that in our older and larger cities, as a rule all wastes are collected through some municipal agency. It is, moreover, apparent that such material can be controlled in no other manner, and that uncontrolled it soon becomes a nuisance and may be dangerous to health. In the opinion of your Committee, therefore, any service to be created, or any proposed modification of an existing service, should be designed to include within the scope of its operations, the collection of ashes, garbage, dead animals, night-soil, miscellaneous refuse, and street sweepings; and the collection of the contents of manure pits, if not so effected, should be regulated as to time and manner of performance. If it be not possible to organize such a service at once, any service which may be organized should be devised so as to be susceptible of being expanded so as to include such work.

With reference to the performance of whatever work may be undertaken, your Committee is of the opinion that it can be done better and more economically by the city through its own employes than through the agency of a contractor. In reaching this conclusion it has been influenced by the following reasons: (1) A contractor, in fixing the amount of his bid, must base his estimated cost of the service upon the probability that at the end of some limited period he will go out of the business, and that his plant will then be nearly a dead loss. His bid, must, therefore, include an amount sufficient to relieve him from such loss. Even a long term contract will not prevent this, for his plant must be kept in good condition even up to and including the last day of his contract in order to enable him to do his work. On the other hand, if the service be performed by the city, the plant may be counted as a permanent investment; each part of it will be used for the entire period of its natural life, and, therefore, no such loss will be encountered. (2) If the work be done by contract, the service must be organized anew with the advent of each contractor, and during this period of organization efficient work cannot be accomplished. Aside from the question ot organization itself, the personnel of the service will be changed each time, new workmen will be unable to perform their duties properly until they have learned them by experience, and such experience must be acquired at the expense of the community. On tht other hand, if the city does the work the organization will be permanent, subject to only such changes as are necessitated to better it. The employes will have a permanent tenure of office and after they have once learned their duties will become more and more efficient during each year of their service. (3) If the work be done by contract the contractor must have a corps of inspectors to see that his employes perform their duties properly, and it will be necessary for the city to have a similar force to see that the work is properly done by him, but if the work be done by the city one force of inspectors will be sufficient. (4) If the work be done by contract, there will usually be several contractors—one for street cleaning, one for collection of garbage, etc.—each maintaining a separate plant and organization. But if the work be done by the city all the advantages will accrue which arise from the performance of all such enterprises on a large scale. (5) If such work be done by contract, there is a conflict between the sanitary requirements and the features essential to secure the greatest money profit, and, as the contractor is in the business for the money he can get out of it, it is needless to say that the financial features will receive first consideration. On the other hand, if the work be done by the city, the sanitary aspects alone will have to be considered, and there will be no inducement whatsoever to neglect them. (6) If the work be done by contract, the city authorities are more or less free of responsibility to the people; they can put the blame for poor service on the contractor or on the details of the contract. But if the work be immediately under the control of the city officers, they must answer to the people whom they serve for the character of the service rendered. Your Committee has not regarded the effect which politics may have on any service which may be under the immediate control of the city. While, unfortunately, this is a factor which must be regarded in any community, it does not enter into the determination of the abstract question. If a community is willing that the municipal services, or any of them, shall be performed less efficiently and more extravagantly because of political influences—that is, if it desires that a part of the money nominally appropriated for cleaning the streets, or for removing the garbage, shall be devoted in fact to political purposes—there is no reason why it should not have it so; but this is a matter which your Committee is unwilling to admit as an essential part of the problem of municipal scavengering. Briefly: Whatever may have been the case when the removal and disposal of city wastes were regarded as simple problems and the work could be done and supervised by unskilled labor, in the view of this problem which is now generally accepted there is no argument for doing such work by contract which is not equally valid when urged in favor of performing the services of the police and fire departments, and of the public schools, in the same way.

Your Committee is aware that in some cities the problem of providing funds to meet the cost of such municipal scavengering as has been proposed, the collection of all city wastes, is a more or less difficult one. In considering it, however, it must be remembered that such work must be done, whether its actual performance devolves upon the householder or upon the municipality. If the former be the case the householder must pay the cost to some personal agent of his own selection and procurement. There seems to be no reason, therefore, why, if the interests of the city will be served thereby, he should not be required to pay the cost of such work to the local government, in the form of a special tax if necessary, in consideration of the service to be rendered by it.

In conclusion your Committee recommends; (1) that all municipal scavengering be performed at municipal expense; (2) that all service necessary for the performance of such work be performed by the city directly and not through the agency of contractors; and (3) that, if necessary, a special tax be levied to meet the cost of such work.

Respectfully submitted,

WM. C. WOODWARD, Chairman,
Health Officer, District of Columbia.
Committee on Disposition of Garbage and Street Cleaning.

Summary of Data Relative to
MUNICIPAL SCAVENGERING,

Collected by the Committee on Disposition of Garbage and Street Cleaning, American Society of Municipal Improvements,
During the Official Year, 1898-'99.

These cities to which inquiries have been addressed are indicated in the statement referring to ashes. In the subsequent statements where no replies were received the name of the city has been omitted.

ASHES.

Allegheny, Pa.—Deposited on public dumping grounds in city limits.
Atlanta, Ga.—Collected by the city.
Baltimore, Md.—No reply to inquiry.
Boston, Mass.—No reply to inquiry.

Bridgeport, Conn.—Used for filling in low lands. Collected at expense of householder.

Brooklyn, N. Y.—No reply to inquiry.

Buffalo, N. Y.—No reply to inquiry.

Charleston, S. C.—Said to be collected at public expense. See City Government, September, 1899.

Cincinnati, Ohio.—No reply to inquiry.

Cleveland, Ohio.—Dumped into ravines and low places about the city. Collected at expense of householder.

Kansas City, Mo.—Dumped on low lands some distance from the city. Collected at public expense.

Louisville, Ky.—Deposited on low grounds. Collected at public expense. See City Government, September, 1899.

Milwaukee, Wis.—No reply to inquiry.

New Orleans, La.—No reply to inquiry.

New York, N. Y.—Collected at public expense.

Philadelphia, Pa.—Collected at public expense.

Pittsburg, Pa.—Deposited on low ground. Collected at expense of householder.

Providence, R. I.—Deposited on low ground. Collected at expense of householder.

St. Louis, Mo.—Collected at expense of householder.

Syracuse, N. Y.—Used to fill streets. Collected at public expense.

Washington, D. C.—Deposited on low grounds. Collected at expense of householder.

Wilmington, Del.—No reply to inquiry. Said to be collected at public expense. See City Government, September, 1899.

DEAD ANIMALS.

Allegheny, Pa.—Converted into fertilizer.

Atlanta, Ga.—Incinerated.

Bridgeport, Conn.—Collected by the city.

Cleveland, Ohio.—Converted into fertilizer. Collected by the city.

Milwaukee, Wis.—Converted into fertilizer.

Philadelphia, Pa.—Converted into fertilizer. Collected at public expense under the garbage contract.

Pittsburg, Pa.—Converted into fertilizer. Collected at public expense under the garbage contract.

St. Louis, Mo.—Converted into fertilizer. Collected at public expense under the garbage contract.

Syracuse, N. Y.—Some of the dead animals are converted into fertilizer at garbage reduction plant, and soon all will be.

Washington, D. C.—Some converted into fertilizer; others disposed of with garbage on waste land outside of the city. Collected at public expense under the garbage contract, and by private individual engaged in the fertilizer business.

GARBAGE.

Allegheny, Pa.—Made into fertilizer.

Atlanta, Ga.—Incinerated. Collected at public expense by employes of the city. Atlanta owned and operated a furnace for the destruction of garbage up to January, 1899. Since that date the destruction of such material has been done under contract. The city destroyed its garbage in a Dixon crematory. The contractor, it is understood, is using a furnace of a new pattern.

Bridgeport, Conn.—Incinerated in a Dixon furnace which began operation in August, 1899. Collected at city expense. Bridgeport formerly used a Holthaus reduction plant, but, as reported by Dr. E. A. McClellan, Health Officer, it proved expensive, caused complaint by offensive odors, and was, therefore, abandoned. The Dixon Crematory Company agreed to erect a suitable building and furnace and to operate the plant for three months, demonstrating that their process is practically odorless, and that it can be done at a cost not to exceed thirty-five cents per ton. Failing to demonstrate this, they will take down and remove the plant without expense to the city. The crematory is located in a part of the city inhabited by workingmen—Huns, Slavs, Italians, etc.

Buffalo, N. Y.—Collected at public expense by contract.

Camden, N. J.—Incinerated in a Dixon garbage crematory, which was erected by the city at a cost of $9,995. It has a capacity of sixty tons per twenty-four hours. The cost of operating, including fuel, labor, and necessary repairs, is about $1,800 per annum. This crematory is near the railroad in a business part of the city. It has been in operation for some years and is reported by Mr. B. H. Shivers, Clerk of the Highway Department, as having been perfectly sanitary and having met the expectations of the city.

Cleveland, Ohio.—Is reduced to fertilizer by the so-called Anderson process. Collections are made three times a week within so-called three-mile limit, being an imaginary circle drawn through the most densely populated portion of the city. At hotels, commission houses, etc., it is collected daily. The work is done under a five year contract at a cost $69,000 per annum for collection and disposal.

Kansas City, Mo.—Is dumped into the Missouri river. During the summer season collections are made in the business portion and thickly settled districts every day, and in the outskirts and more thinly settled districts two and three times a week. During the winter collections are made two and three times a week in the business districts, and about once or twice a week in the residence section. The work is done by the employes of the city, under control of Board of Health. The force employed in doing the work during the summer season consists of twenty-five teams, the drivers of which are paid $3.00 per day for each working day.

Louisville, Ky.—Is dumped on low lands. The term garbage in Louisville includes refuse of all sorts—meat, paper, old shoes, old bottles, ashes, etc. Collections are made daily during the entire year. The material is collected by employes of the city.

Milwaukee, Wis.—It is now buried on farms in the suburbs and covered with six inches of ground. Collected by employes of the city, under control of Health Department. Garbage was formerly collected under contract, the amount collected and disposed of during the last year of such contract being about 25,000 tons, and the cost $76,000. The material was collected triweekly and was disposed of by the Merz reduction system, the establishment being located some miles out of the city. Since the expiration of this contract the Health Department itself has been collecting and disposing of such refuse, the disposal being effected in the manner above indicated. A daily and triweekly service is given. The amount collected and disposed of during the past year was 28,716, and the cost $61,358. (See City Government, September, 1899). Reduction has apparantly been abandoned. The city let a contract for the erection of a garbage crematory, but the construction was stayed by injunction, and new bids have been advertised for.

Muncie, Ind.—Is disposed of by incineration. The collection and disposal are both under the immediate control of the city. The plant, including the crematory, cost about $5,000. The crematory has a capacity of approximately twenty-five tons per day. In the year 1898, 3,775 tons of material were collected and destroyed, at a cost of $3,331.42, an average cost of approximately 88¼ cents for collection and disposal. Mr. Frank C. McGrath, the superintendent of the crematory, informs us that it has been operating without nuisance and has met the expectations of the city at the time of its installation.

Philadelphia, Pa.—Disposed of by Arnold reduction process. The work is done at public expense, by contract. The disposal plant is located on the Schuylkill river at some distance from the better section of the city. Mr. Sylvester Martin, Chief of the Bureau of Street Cleaning, informs us that there is no complaint against the mode of disposal.

Pittsburg, Pa.—Disposed of by Flinn reduction process, which is a modification of, and said to be an improvement upon, that of the American Reduction Company. The work is done at public expense, by contract. We are advised by the American Reduction Company, which controls this plant, that no chemicals are used in the process employed at Pittsburg. The garbage is merely converted into tankage there, and the extraction of grease by naptha, and the manufacture of fertilizers, is effected at its fertilizer plant near West Newton, Pa. The particular feature of this system in which it differs from others appears to be the combination of the gases with steam before they are allowed to enter the furnaces in which they are destroyed.

Providence, R. I.—Almost all garbage is fed to swine. The work is done at public expense, by a contractor, but the contract merely runs from month to month while a committee is investigating the subject of garbage disposal. Collections are made three times a week in the summer, and twice a week in winter. The collection amounts to about 12,000 tons per annum.

Savannah, Ga.—Disposed of by an Engle crematory. This crematory was built in 1891, at a cost of $18,870. The cost for repairs since its erection has been $4,841. It has had an average capacity of from 25 to 30 tons per day, but is now out of repair and can dispose of but 20 tons during the same period, at a cost of about 90 cents per ton. Complaints from property owners in the vicinity have been frequent. The crematory will be abandoned next year, and a new one erected.

St. Louis, Mo.—Is disposed of by Merz reduction process. Collections are made at public expense, by contract, daily during the entire year. A new contract has just been made, for a term of ten years at an average annual cost of $122,500.

Syracuse, N. Y.—Is disposed of by the Holthaus reduction system. The work is done under contract. Dr. O. A. Thomas, Health Officer, reports that the odor emanating from this plant is "a sort of medicinal one and perfectly inoffensive," and believes that his city has solved the probelm of garbage disposal.

Toledo, Ohio.—Some is disposed of by depositing on grounds outside of the city; much of it is fed to animals intended to be used for food. The work is done at public expense, by contract. The Mayor, Hon. S. M. Jones, desired to have the city do the work and, therefore, vetoed the contract, but the Council passed it over his veto.

Washington, D. C.—Is used as a fertilizer on waste land outside of the city. Transportation is by river, and when travel is obstructed by reason of ice or otherwise, disposal is effected by a Brown garbage crematory. Collections are daily, triweekly, and semi-weekly. Collection is at public expense, by contract. The amount of material collected during the last fiscal year was 20,946 tons, and the cost, including that of collecting and disposing of dead animals, $57,000.

Wilmington, Del.—Is disposed of by a Dixon garbage crematory. The work is done at public expense, by contract. A Brown garbage crematory was in use prior to the erection of the present device.

MISCELLANEOUS REFUSE (RUBBISH).

Atlanta, Ga.—Disposed of by incineration. Both collection and disposal are at public expense, the former by employes of the city, the latter by contract.

Bridgeport, Conn.—Disposed of at the expense of the householder.

Cleveland, Ohio.—Disposed of at the expense of the householder.

Louisville, Ky.—Deposited on low lands. Collected by employes of the city along with garbage.

Pittsburg, Pa.—Some is burned; other is deposited on dumps both in and out of the city. Collected at the expense of the householder.

Providence, R. I.—Disposed of at the expense of the householder.

Syracuse, N. Y.—Deposited on low grounds. Collected at public expense.

Washington, D. C.—Deposited on low grounds. Collected at the expense of the householder.

NIGHT SOIL.

Allegheny, Pa.—Is taken away in boats and deposited in streams outside of city limits.

Atlanta, Ga.—A part is cremated; the other is deposited in pits outside of the city. Is collected at public expense by employes of the city.

Bridgeport, Conn.—Is disposed of to farmers. Collections are made by licensed scavengers.

Cleveland, Ohio.—Is dumped into Lake Erie.

Kansas City, Mo.—Is dumped into the Missouri river some distance from the city. Is removed at expense of the householders.

Pittsburg, Pa.—Is deposited in neighboring rivers. Removal is effected by licensed collectors at the cost of the householder.

Providence, R. I.—Is dumped on land and is used as a fertilizer, mostly in adjoining towns. Is collected by licensed scavengers at the expense of the householder.

Washington, D. C.—Deposited on waste lands some miles outside of the city. Collected by a licensed scavenger at the expense of the householder.

STREET SWEEPINGS.

Allegheny, Pa.—Deposited on the wharves and on vacant lots.

Bridgeport, Conn.—Carted to the city farm.

Kansas City, Mo.—Deposited on low lands some miles outside of the city. Cleaning of streets effected by employes of the city, requiring the services of 163 men, with compensation at the rate of $1.75 per day, and 42 men with wagons, with compensation at the rate of $3.00 per day.

Louisville, Ky.—Deposited on low lands, and some used at the poor farm. Collected at public expense, by employes of the city.

Pittsburg, Pa.—Mixed with manure and other material and used as a fertilizer in the public parks. Collected at public expense.

Providence, R. I.—Poorer grades of sweepings are used for filling low lands. The better grades are sold to farmers for fertilizing purposes. Collected at public expense.

Washington, D. C.—Deposited on low grounds. Some of the better grades have been sold for fertilizing purposes. Collected at public expense.

THE PRESIDENT: There is also a paper by Mr. Herrmann of Cincinnati to be read. Mr. Herrmann was called away unavoidably and had to leave early, but I think Dr. Woodward has the paper and will read it.

Paper No. 25—"The Collection and Disposal of Garbage in the City of Cincinnati"—by August Herrmann, Commissioner of Water Works, Cincinnati, O., read by Dr. Woodward as follows:

DISPOSITION OF GARBAGE AT CINCINNATI, O.

BY AUGUST HERRMANN PRES'T BOARD OF TRUSTEES, COMM'RS OF WATER WORKS.

At the request of Dr. Wm. C. Woodward, Chairman of the Committee on "Disposition of Garbage and Street Cleaning," there has been prepared and is now submitted to the Society, a short statement relative to the "Disposition of Garbage" at Cincinnati, Ohio.

Previous to 1892 the garbage from dwellings and other places, after being collected by the Street Cleaning Department, was hauled to the various public dumps, and there deposited in the same manner as street sweepings, ashes and refuse of all kinds. It was the practice of the Department, after dumping the garbage, to spread a layer of lime over it each day. This eliminated, to a certain extent, the obnoxious odor that would necessarily arise from dumps of this character. There was great complaint, however, from the citizens residing, or doing business near these dumps, as well as from those who were compelled to pass them daily. Finally, in 1892, specifications were prepared and adopted, and proposals solicited thereunder, and a contract entered into, providing for the disposition of vegetable garbage.

Under this contract the contractor agreed to erect, operate and maintain a plant for the scientific and sanitary disposition of the vegetable garbage of the city, and dispose of the same in a manner not injurious to health or comfort, and in accordance with certain printed specifications, for the following graduated yearly payments, covering the entire period of the contract, viz.—ten years,—the city delivering the garbage to the contractor:

1st., year	$15,000
2nd., year	17,000
3rd., year	19,000
4th., year	21,000
5th., year	22,000
6th , year	23,000
7th., year	24,000
8th., year	25,000
9th., year	26,000
10th., year	27,000
Average charge per year	$21,900

The system employed in the disposition of the garbage by the contractor is what is known as the "Simonin Process." It will be noticed that the City collects the garbage and delivers it to the Contractor. This delivery is made on a flat boat lying in the river near the southwestern part of the city. From this point it is towed away by the Contractor to his plant, which is located about five miles below the city.

The principal conditions of the contract are as follows:

1st. Within ten days after the passage of the ordinance accepting the proposition, the Contractor shall enter into a contract with the city, agreeing to receive from the city of Cincinnati at such point or points as may be agreed upon and designated in said contract, all the vegetables and kitchen garbage that may be collected and delivered by the city at such point or points, the same to be unmixed with ashes or other refuse matter, for and during the full term of ten years from and after the making of said contract; the city agreeing on its part to prevent the dumping during said period of all such garbage at other places, and further agreeing to so collect and deliver as aforesaid all such garbage.

2nd. The contractor binds himself by said contract to dispose of all such garbage so delivered to him, as aforesaid, in a mode not injurious to health or comfort; the delivery of the garbage not to be commenced, however, until the necessary plant apparatus and facilities for the disposition of the same have been provided by the contractor, and notice of his readiness to receive the same given; the contractor binding himself, however, to complete the construction and operation of said plant with all possible dispatch.

3d. In consideration of such disposition of said garbage by the contractor, he is to receive the sums already referred to herein, payments being made monthly. He is also required to give a bond in the sum of $25,000, that he will faithfully carry out the conditions of the contract.

The plant has now been in operation about six years. No complaint has ever been received from persons residing in the immediate neighborhood thereof.

The total amount of garbage delivered per annum by the city does not exceed 15,000 tons, and is constantly decreasing. This can only be explained by one of three reasons:—Either the citizens are careless in not keeping the garbage in separate vessels,—in other words, mixing it with refuse and ashes, thus preventing its separate collection and delivery to the Company, by the Street Cleaning Department; or the Street Cleaning Department is negligent in delivering to the Company what it actually collects,—the haul in certain instances being many miles. In either one of these cases, the garbage finally finds its way to one of the public dumps. The third reason assigned for the falling off in the amount of garbage delivered is, that the consumption of garbage for fuel for domestic purposes is constantly increasing. That this is a fact, has been demonstrated by a careful examination in certain districts. It may also be added, that where garbage is consumed for this purpose, it generally gives satisfaction, especially in the winter season.

While on this subject, attention is also called to the manner in which dead annimals and animal offal are removed from the dwellings, hotels, stock-yards, slaughter-houses, streets and other places in Cincinnati.

In 1893, specifications were adopted providing for the removal of all dead animals, animal offal, etc., and after due advertisement, proposals were received and a contract awarded for doing this work.

This contract may be summarized as follows:

1st. The contractor makes no charge to the city for the removal of dead animals and slaughter-house offal from the streets and all other places within the city; neither will he pay anything for the privilege of removing such dead animals and slaughter-house offal from the streets and all other places within the city; but he will remove such dead animals and slaughter-house offal from the city and all other places within the city in consideration of the award to him of the privilege so to do.

2nd. The contractor to enter into a contract within ten days after his proposal is accepted, the same to run for a full period of ten years. Within 120 days thereafter he shall enter upon the performance thereof. He shall remove all slaughter-house offal daily in covered wagons of such character as shall be approved by the Board of Administration, but which character after it has been once approved is not to be changed without the censent of both the Board of Administration and the said contractor; to immediately provide for the removal and to promptly remove in covered wagons, in such manner as will least offend the sight or smell, any animal dying from disease, condemned, or unfit for food, or which has been killed by accident, upon receiving notice thereof; to cause the removal of carcasses and dead animals and slaughter-house offal to be made at such hours as shall be prescribed by the Board of Administration, and in such manner as will least offend the sight or smell; and to cause all dead animals and slaughter-house offal so removed under the contract entered into between the city of Cincinnati and the said contractor, to be taken beyond the city limits to be disposed of. He shall also have the right to the use of a wharf free of any costs whatever, to be designated and provided by the Board of Administration for all wharf purposes connected with the performance of the contract, should such be required. This right, however, shall not be construed to cover or include the use of a wharf-boat.

3d. A bond is required in the sum of $25,000, with at least two sureties, who shall qualify as owners of real-estate of the value double the amount of said bond, conditioned that the contractor shall faithfully carry out all of the provisions of the contract.

In conclusion, I desire to state that if any additional information is desired, either by the Committee, or any of the members of the Society, the same will be promptly furnished upon application.

THE PRESIDENT: Mr. Jones, the Street Commissioner of Toronto, has also prepared a paper on this subject; and I am sure, after riding over many miles of particularly clean streets this morning, we shall be very glad to hear how Mr. Jones does it.

MR. JONES: Before reading the paper, Mr. President and Gentlemen, I have been requested by the Park Commissioner of this city, Mr. John Chambers, to propose his name as a member of this Society, and I now propose that Mr. John Chambers, Park Commissioner of the city of Toronto, be a member of this Society.

MR. SAUNDERS: I second that motion.

On motion, the meeting reverted to order of business No. 3.

MR. TILLSON moved, seconded by Mr. McMath, that the Secretary cast a ballot on behalf of the Society in favor of Mr. John Chambers as a member of the Society.

THE SECRETARY cast a ballot.

THE PRESIDENT: On the report of the Secretary I have much pleasure in declaring that Mr. John Chambers, Park Commissioner of the city of Toronto, has been unanimously elected a member of this Society.

AN OUTLINE OF THE SYSTEM OF GARBAGE COLLECTION AND DISPOSITION IN THE CITY OF TORONTO.

BY THE STREET COMMISSIONER, MR. JOHN JONES.

At the request of Dr. Woodward, Chairman of the Committee on garbage disposition, in connection with this Convention, I beg to submit a few facts and details bearing on the Scavengering service as carried on in this city under my supervision.

I must explain at the outset, however, that I have little really new to add to the remarks I had the privilege of addressing to this Convention on the subject in question, at the meetings held in Cincinnati and Washington. All that I can hope to do therefore is to refresh your memories on what I said on the occasions I have just alluded to, while going a little more into the details of our system, and adding some facts relating to the expenditure, and other items connected with the service for the year ending December 31st, 1898.

I purpose also to give the Convention some information regarding the construction, method of operating, and expenditure involved in running the crematories, where the garbage is consumed, which has been kindly furnished me by our esteemed City Commissioner, Mr. Coatsworth, under whose supervision they are conducted.

One important advantage I may point out, namely, the holding of the Convention here will afford the members an opportunity, as Dr. Woodward mentions in his letter, "of seeing how such work is accomplished in Toronto," adding also that "it will be of especial interest to learn the details." As head of the Department having control and supervision of this very important service, I extend a cordial invitation to the members, and any of their friends who may be visiting our city, to avail themselves of the opportunity to examine our system of conducting the Street Cleaning, Street Watering, Scavengering, and other branches of municipal work belonging to the Department. The city yards, stables, shops, docks, etc., will be open for your inspection at all times, and it will give me the greatest pleasure to afford the members and their friends any information they may desire. In extending this invitation I know that I am voicing the sentiments of His Worship the

Mayor, and Council, whose earnest wish, together with the citizens at large, is that your visit may be made as pleasant and profitable as possible.

The total area of the city, including the bay, and Island, is 13,976 acres, of which 10,500 acres are occupied. The mileage of the streets is 258.30, and of the lanes or alleys about 75, miles; the latter nearly all unpaved. Our population is about 230,000; the buildings number 41,500, of which 36,418 are dwellings, and the balance (5,082) business places.

For the operation of the Scavenging service we have divided the city into two districts, eastern and western, each being in charge of an inspector, who also has charge of the Street Cleaning, and Street Watering branches in his district. These districts are again laid out in sub-divisions, the number of which throughout the city is 29. Each of these sub-divisions is again divided into "beats" or routes, one cart or team wagon being alloted to each "beat"; from eight to twelve carts on an average being required for each sub-division. In order to ensure the proper performance of the work, and at the same time be able to locate any driver who may neglect his duty, or in other ways give cause for complaiht, I have appointed one driver in each sub-division as head, or senior over the others, who is responsible for the work being properly performed in his particular sub-division, and whose duty it is to investigate, Moreover, each cart bears a number, whereby any dereliction of duty and report on all complaints that may affect his staff of drivers, to the inspector of the district, by whom the facts are transmitted to the office. can be more readily traced to the right party. The central portion of the city, which is the most thickly populated, and contains most of the business houses, is covered by the carts twice weekly; the remaining section, comprising the residential portion, and outskirts, having a weekly collection only.

Employed in this work we have 120 horses, with carts and wagons of varying capacities, all the property of the city, built and kept in repair at our own shops. We have three stables for our horses, one in the western, one in the eastern, and one in the northern section of the city.

Coming now to the statistics for last year, we removed altogether 115,679 loads, of which 35,085 loads were garbage, and the remainder, namely, 80,594 loads, were ashes. It may be well to explain here that the term garbage covers all substances that are combustible. Of pure garbage, that is, kitchen refuse, comprising animal and vegetable matter, the proportion of the aforesaid quantity removed last year was only about one-twelfth, or 8.33 per cent., the remainder consisting of brush wood, and debris from lawns and gardens, clippings and waste end of cloth, leather, etc., from factories and warehouses, waste paper, and odds and ends generally that will burn, all of which was disposed of at the crematories. It may be a matter of surprise to some of the gentlemen present that the percentage of pure garbage is so small. One reason is, practically all the refuse from our large hotels; and boarding houses, is sold to persons maintaining piggeries outside the limits of the municipality, who also have men employed to collect the refuse when put out by householders for the scavengers to take away. Another reason is, many families make a practice regularly of burning their garbage in the kitchen stoves. Dead horses are removed by a private firm outside the city, at their own expense.

I am aware that the disposal of garbage, whether by reduction, or incineration, is occupying a good deal of attention at present in large cities both in the United States, and in England, some of which have adopted the former process, and I recollect we had an interesting discussion on the subject when the Convention met in Washington last year. I am not prepared to pass a definite opinion on the question as to whether it is profitable for municipalities in general to adopt the reducing process for disposing of garbage, in preference to other methods, as local conditions vary in each case, and the process is not yet beyond the stage of experiment, but I have no hesitation in saying that it would not pay this city to adopt that system in preference to our present system of incineration inasmuch as the amount of pure garbage we collect is so small.

As I have before mentioned, all combustible matter is sent to the crematories, and the dry substances form valuable fuel for disposing of the moist collections. Ashes are used for filling-in purposes.

The collections are made from the various sections of the city on the same days of each week, printed cards containing information when the carts make their rounds, the regulations governing the service, etc., being served on every householder. One of the most important of these regulations prohibits the storing of ashes and garbage in the same receptacle. Under a process of incineration such as we have, it is obvious that the combustible, and non-combustible substances must not be mixed, nor do we find it difficult to enforce this rule. I must confess, however, that we have more trouble in getting citizens to observe another very important regulation, namely, one which prohibits ashes and other substances from being thrown broadcast on lanes or alleys. We have, however, special men appointed to patrol the lanes for the purpose of compelling a proper observance of the rules and regulations governing the service, and we rarely find it necessary to do more than issue a warning to offenders. I may mention also that we have the co-operation of the Police toward this end.

The expenditure on the service last year was $62,482.96, representing a cost per head of population of 27.17 cents, and per load removed of 54.01 cents. The expense of the work is largely increased by the long haul to the dumps where ashes are deposited, none of which are centrally located.

It might be supposed that the proportions of ashes and garbage, so called, would vary considerably in the winter and summer seasons, but we do not find a very great difference. For the information of the Convention, I have selected the returns from a district which is largely residential, for one week, each, in the months of January and July of the current year:

Average number of carts collecting..................13.
Month of Jan....213 loads of ashes, and 80 loads of garbage removed.
Month of July...102 loads of ashes, and 117 loads of garbage removed.

There is, however, much difference in the quality of the matter collected. In winter the ashes are pure and unmixed, but in summer there is a great proportion of sweepings of yards, and out-houses, and such like, all of which is useful for filling low lying lands.

The substances classed under the head of garbage vary but little one month with another.

Mr. Jones: I am sorry this paper has come up so late in the session, because it was my intention to invite any and all the members of the Society who wished to go over our system with me; and I beg to say now, that if any of the members have the time this afternoon or remain in Toronto until to-morrow, it will give me extreme pleasure to take them around, show them our crematories, our yards, and the system on which the work is conducted.

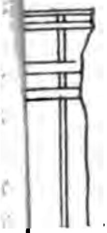
Our City Commissioner, Mr. Coatsworth, has supplied me with a short paper upon the method of cremation, the erection of crematories and the cost, and has also given me from 18 to 20 copies of a plan drawn to a scale of the elevation of the crematories, which I will be happy to supply to the members of the association. Mr. Coatsworth's report is as follows:

City Commissioner's Office, Toronto, Sept. 30th, 1899.
John Jones, Esq., Street Commissioner:
Dear Sir:

RE-GARBAGE CREMATORIES.

In compliance with your request I beg to submit the following statement:

About 1884 the garbage dumps in our city became a nuisance, and for 5 or 6 years the subject of erecting a crematory was under considera-



…ORK
…BRARY.
…OX AND
…DATIONS.

tion by the City Corporation, plans of several kinds of crematories were obtained from England and the United States, all of which were found to be more expensive in their construction than the need of our city warranted, and from information obtained, it was discovered that many of them were offensive in their operation, deputations from our City Council visited several cities of the United States and Canada for the purpose of gathering information on the subject.

In the early part of 1891, the City Commissioner was ordered, by resolution of Council, to construct a crematory by day labor according to plans prepared by himself, a copy of which is herewith appended, having two furnaces each 22 ft. long, 10 ft. wide, and 4 ft. high to crown of arch, with iron smoke stack 3 ft. in diameter and 100 ft. high, capable of cremating 100 cubic yards per day of refuse and garbage, it was erected in the eastern part of the city .

The operation of the eastern crematory having proved satisfactory, the Commissioner was instructed, in the early part of 1893, to construct one of a similar kind in the western part of the city, which was completed and put into operation about the 1st of October the same year, the size of the furnaces being 28 ft. long by 10 ft. 4 inches wide, and 4 ft. 3 inches high to crown of arch, with a brick smoke stack 120 ft. high, having a cremating capacity of 120 cubic yards of refuse and garbage per day.

The following figures will show the cost of operation, material consumed, in the years named at the two crematories. We give these years in order to show the average:

1894—Refuse and garbage cremated, 40,000 cubic yards, at a cost of 27½ cents per yard.

1897—Refuse and garbage cremated, 54,000 cubic yards, at a cost of 22½ cents per yard.

1899—Garbage and refuse cremated to September 23d, 33,000 cubic yards, at a cost of 22 cents per yard.

The eastern crematory cost for construction, in labor and material, for the furnace and smoke stack	$4,400.00
Wooden building 48x98 ft. 22 ft. high, and a bridge for approach from street and fencing lot	3,000.00
Total	$7,400.00

The western crematory cost for construction, being a little larger than the other, with a brick smoke stack, in labor and material, furnace and chimney	$4,914.00
Building, planking roadway, etc	2,600.00
Total	$7,514,00

All kinds of garbage, refuse, dead animals, rotton meat, fruit, fish, vegetables, etc., are cremated. Cheap soft coal screenings are used as fuel, about two tons per day at both institutions.

There are no offensive odors at any time emanating from the crematories; they might be placed in the heart of the city and would be no nuisance.

So far as my knowledge goes, from information I have been able to gather for the past 10 years on the disposal of garbage, I believe that cremation is the best and most sanitary method of treating it. So far as our city is concerned, it is the only system suitable, as we get so much more refuse than garbage. (Signed),

E. COATSWORTH, City Commissioner.

MR. DRAKE: I understand by this report that you have to use fuel in connection with the refuse.

MR. JONES: Yes.

MR. DRAKE: There are crematories where they use no fuel whatever.

MR. JONES: The City Commissioner says that coal screenings are used, about two tons per day, for the purpose of cremating; that, I suppose, is taken in connection with the refuse that is dry enough to burn. I do not know exactly what we pay for our soft coal screenings, but I think we get them pretty cheap. We use about two tons a day at each crematory.

A MEMBER: I would like to ask if the draught is obtained from the chimney or from a forced draught.

MR. JONES: The height of the chimney is the only draught. I have said to the City Commissioner, under whose charge the crematories are, that he would burn less fuel if he could create an under-draught, but he seems to think the height of his chimneys gives him all the draught that is required.

THE PRESIDENT: I believe there is a paper by Mr. Wiley. It is a question whether the Society would desire to have this paper read or simply printed in the report of the meeting.

MR. TILLSON moved, seconded by Mr. McMath, that Mr. Wiley's paper be received and printed in the minutes of the Proceedings. Carried.

COLLECTION AND DISPOSITION OF GARBAGE AND STREET SWEEPINGS IN WILMINGTON, DELAWARE.

The subject of collecting and disposing of garbage and street sweepings, presents a degree of magnitude never considered seriously by citizens as individuals or collectively; the matter being left to Municipal Department officers to wrestle frequently without adequate approriation of money, thereby necessitating the introduction of indifferent methods; the results being indiscriminately condemned, be they good or bad. As this subject has been discussed time and again to the interest of all, and our enlightenment on many points heretofore obscure, it is unnecessary to enter into minute details.

Generally speaking all kinds of municipal waste are included by the term "Garbage." Mention garbage to the public and note the immediate and involuntary upward turn of the nose as the mind instantly reverts to the odors emanating from organic waste decaying and putrefying, causing offense and often dangerous to health and life, no thought being bestowed upon inorganic waste which includes every kind of dry worthless refuse known to housekeeping, except ashes.

It is generally conceded that garbage contains about 70 per cent. ot water held in suspense as it comes from houses, the remaining 30 per cent. being composed of rubbish and dry animal and vegetable matters.

In our city of Wilmington, having a population of 75,000 inhabitants, the inorganic garbage is collected during the first four days of the week in covered wagons or carts and is, at the present time, dumped on outlying low roadways where all inflammable refuse is burned. Organic garbage is collected daily and delivered in steel wagons to the Crematory known as the "Dixon" system, having a capacity of 80 tons per day; the annual cost of collection and consumption or disposal of organic garbage being $14,000; the residuum—ashes—being sold at the rate of $2.50 per ton at the plant. It may be well to say that the work of collecting organic waste is done by contract labor under direction of the Health department and delivered to the Crematory owned and operated by the municipality, while inorganic waste is collected by contract under direction of the Board of Directors of the Street and Sewer Department; the cost of this work being $7,500.00 per annum, making the total cost for collecting and disposing garbage amount to the sum of $21,500.00 per annum.

STREET CLEANING.

The work of sweeping and cleaning the 94 miles of both improved and unimproved streets, is performed by day labor under direction of the Street Commissioner, Mr. Frank W. Pierson, at an average cost of about $8,500.00 per annum; improved highways throughout the city being cleaned daily by the hand cart patrol system, twenty workmen being thus employed, who, after sweeping and collecting sufficient refuse to fill a barrel, dump the same at convenient stations in stable-yards on their routes; other portions of the city being swept and cleaned bi-weekly by the combined employment of day labor and machine brooms.

The sweepings are sold, when possible, to garden truck farmers for fertilizing purposes. Otherwise it is carted to the marsh roadways near the river for filling purpose; except that dumped in stable-yards, which becomes by agreement the property of the stableman and is disposed with stable waste.

HARVEY J. WILEY,
Sec'y Street and Sewer Dep't, Wilmington, Del.

MR. DRAKE: As the city of Buffalo has more or less garbage to dispose of, perhaps it would be interesting to the gentlemen present to have a very short statement of how we proceed in the matter.

We have a territory of something like forty square miles. The average haul of the garbage is four and a third miles. We do the work on the contract system so far as collecting and delivering the garbage to the crematory or reduction works is concerned and it is reduced under the Merz system, that is to say, the grease is first extracted and the balance reduced to a dry condition and utilized as a fertilizer, so that there is nothing wasted—nothing destroyed. The only thing that troubles us to get rid of is the numerous tin cans and old scrap iron that finds its way to the crematory with the garbage.

The system was established in 1888, I think, by the construction of what was known as the Baines' Garbage Crematory a few rods outside of the city line. A contract was entered into for five years for the destruction of the garbage, the city of Buffalo to do the work of collecting and delivering. The same force of men that collected the garbage also collected the ashes and other refuse which is used for filling low places. This method was continued for the first five years; a new contract was then entered into with the garbage people, and an increased price was paid, amounting to $35,000 a year. In the meantime the amount of garbage had increased to the extent of about 28,000 tons per year, and the ashes and other refuse, of course, had increased correspondingly. The total cost of collecting and delivering the garbage and disposing of the ashes was something like $135,000 a year. It had reached that point, when the Legislative Body thought it was too much—in fact, it exceeded the amount that was appropriated for that purpose, and so the Board of Public Works was directed to prepare plans and specifications and advertise for proposals for doing the collecting and delivering. Proposals were received. A contract was entered into, which, upon the face of it, appeared to be very much to the city's advantage; but experience has taught us that it cost more under the contract—as the ashes were moved for so much per cubic yard and the garbage for so much per ton—than when the city did the work; and in addition to the cost on the part of the contractor was the cost of supervision, which amounted to something like $14,000 per year.

However, the contract was carried out. It extended over a period of three years, and then we were directed to prepare plans and specifications and to advertise again. We changed the specifications in this way: We advertised for per cubic yard for ashes and per ton for garbage proposals, and also an entire bid was requested for so much, per lump sum, by districts, and by the city as a whole. In the meantime the contract for the reduction of the garbage had expired, and new bids were asked for; and when received the bids ranged from $45,000 a year, which was named by the parties who controlled the crematory, down to $15,000 a year, which was made by a reputable firm of contractors; and after a long and hard fight we were enabled to give the contract to the lowest bidder. Great fears were expressed by many prominent citizens, as well as by newspapers, that trouble would ensue—that the work would not be done in a sanitary manner. We felt confident that it could be done, and finally carried our point, and the contract was let. In a few days both the highest bidder and the party to whom the contract was let came in and asked us to consent to the transfer of the contract to the highest bidder at the $15,000, which we were only too ready to do. So we have that contract, extending over a period of four years, at the rate of $15,000 a year, which formerly cost us $35,000 and for which they wanted $45,000.

New bids came in for the collection of ashes and garbage, and it was found that the lump sum bid was a much more favorable one for us; for what had been costing up between $140,000 and $150,000 we are now getting done for $80,000, plus the cost of the city supervision, we retaining the same men and the same system of collection by districts that we had when the city did the work itself. So we feel that the contract system, so far as the city of Buffalo is concerned, notwithstanding the report of the Committee—and I have great respect for the members of that Committee and also for the report—is the best one; and we feel we are saving money by adopting the contract system. The city of Buffalo proposes to pay every man who works for the city $1.50 for eight hours' work, but that is not the prevailing rate of wages in that city, and the contractor is enabled to hire his men for the prevailing rate of wages. And in regard to teams, the Legislative Body, in the largeness and kindness of its heart, insists that for teams employed by the city of Buffalo, no matter how anxious they may be to find jobs, no matter how much of a surplus of teams there may be lying idle, we shall pay $4.00 a day for eight hours' work; while the prevailing rate, until this summer, has been not to exceed $3.20 for eight hours' work—40 cents an hour. Then again, the city's servants having charge of the work were always ready to accommodate the citizens, and the result was they were moving trees or anything that the citizens wanted. I think if a citizen had asked them they would have moved household goods from one part of the city to another; and of course, that swelled the expense.

Then there are other difficulties. In that portion of the city that confines its fuel to natural gas there is no way of citizens burning their newspapers, and we pay thousands of dollars for getting rid of newspapers; loads after loads are collected and carted away to some dumping place, and then from there they blow all over creation, and we have trouble again. Now, I believe that the contractor proposes to ascertain if there is not a commercial value for old paper.

By the way, I neglected to say that the same parties who are doing the collecting and hauling of this stuff now are the ones who had the contract formerly, and who were paid about $140,000; and they are willing to do it now on a lump sum for $80,000.

With regard to the reduction of the garbage, as against cremation, I have given the matter considerable attention. I visited San Francisco to study into the workings of the crematory at that town—I think they have one of the same character in Montreal also. There they use no fuel whatever except what is collected in the shape of paper and horse manure, and so on, collected on the street; that is all the fuel they require, by reason of the arrangements of their draught. So, I think, the city of Toronto is wasting some money in buying coal, because they can burn their refuse and garbage without any fuel.

Now, in regard to the sanitary question, I do not suppose the city of Buffalo would allow us to locate a crematory—I do not care what its condition was, or what safeguards were thrown about it—under any circumstances whatever. I know it was tried several years ago, and if any one dared to advocate it the people were ready to drive that party out of town. I am satisfied that the reduction works certainly are sanitary, for the reason that very few complaints have ever been made in regard to them; and since the garbage and kitchen waste has been disposed of in the present manner, the death rate of the city has been steadily going down. In 1893—it had just about reached to a proper working at that time—the death rate was twenty-three and a fraction per thousand; but since then there has been a reduction every year, until last year it was 12.25; and we hope, by pursuing the same course, that in a little while the only deaths that will happen in the city of Buffalo will be from old age.

This is a matter that I think the Society should give a great deal of attention to. There are other methods of disposing of garbage coming up. There is a process now whereby the garbage is used in manufacturing gas, and it is claimed that one ton of garbage will produce eleven and one-third cubic feet of gas of a very high illuminant, thirty-nine and a fraction candle power.

I venture to say by the time our present contract expires, four years hence, that it will have a commercial value that will nearly, if not quite fully, pay for the expense of collecting.

Of course, we cannot claim that the manner in which it is disposed of now is entirely the cause of the low death rate of the city of Buffalo, but it is a very large factor. The clean streets and alleys and the abundant use of water go far towards making it what it is—one of the healthiest cities there is in the world; and we hope to convince the members of this Society, when they have their Convention in Buffalo in 1901, in the Pan-American year, that our method, if not the very best, is one of the best extant.

THE PRESIDENT: Gentlemen, is there anything more to be said upon this subject?

MR. MCMATH: There is more to be said, but we do not seem to have time to say it.

THE PRESIDENT: Next on the program is the report of the Committee on City Government and Legislation, with Notes on the Charters of American and European Cities," by F. W. Cappelen, Consulting Engineer, St. Paul, Minn., Chairman of the Committee; but I have received, within an hour or two, a letter from Mr. Cappelen, the Chairman of the Committee, which I will read to you.

N. P. LEWIS, C. E., PRES'T AM. S. M, I., CITY HALL, TORONTO:
DEAR SIR:
Minneapolis, Minn., Oct. 2, 1899.

I sincerely regret that it is impossible for me to be present at the 6th Annual Convention of the Am. S. M. I., but urgent business absolutely prevents me with reference to the report on City Government and Legislation, I beg to report progress as follows:

Realizing the great importance of the subject I intended to put considerable work and energy upon the same and entered into correspondence with City Officials in this country and with U. S. General Consuls of practically all large cities of all foreign countries.

I soon found out that I would not have time to present a paper as I wished to do and therefore ask the Society to grant me further time and I will be able within a few months to present a paper in printed form to each member, that I hope will be of interest and which then could be discussed at the next meeting.

So far I have studied the charters and made extracts from some of the following cities:

San Francisco, Cal.; Seattle, Wash.; Milwaukee, Wis.; St. Paul, Minn.; Minneapolis, Minn.; Indianapolis, Ind.; New Orleans, La.; St. Louis, Mo.; Greater New York and Toronto, Ont.; Zürich, Switzerland; Vienna, Austria, and have before me the charters and municipal laws of the German Empire; Calcutta, India; Sydney, N. S. W.; Wellington, New Zealand and also certain information pertaining to Shanghai, China.

From several other cities have yet to hear and will not give up till I get the desired information, which it appears it is rather difficult to obtain.

I intend to give general information derived from the various sources and then will attempt to make suggestions as to how a city should be properly governed.

Respectfully submitted,

F. W. CAPPELEN,

Chairman Com. City Government and Legislation, Am. S. M. I.

THE PRESIDENT: What is the pleasure of the Society with regard to Mr. Cappelen's request, that he be allowed several months' more time? Would it not be better to try to hurry him up a little so as to get his paper in shape to be printed in the proceedings of this Convention? If that is to be done, it will be necessary for him to be prompt, as the new Executive Committee will want the papers just as soon as possible. I leave the matter to the meeting to decide.

MR. SHERRERD: I move that the Secretary be instructed to request Mr. Cappelen to finish his paper in time for publication in the report of the proceedings of this Convention.

MR. AMES: I will second that motion.

THE PRESIDENT put the motion, and, on a vote having been taken, declared it carried.

MR. M. N. BAKER, Engineering News, New York: I would like to say just one word in connection with Mr. Cappelen's letter, to the effect that the National Municipal League has, through a committee, prepared what it terms a model city charter—I spoke of this the other day—and that charter was presented at the Indianapolis meeting of the League last year, and was discussed very extensively, and was referred back to the Committee for further study and for report at the meeting of the League this fall. I suggest that those interested in this subject would do well to address the League for a copy of that charter and of the Committee report, which will be printed and circulated probably in advance of the coming meeting. You can address Clinton Rogers Woodruff, Secretary National Municipal League, Philadelphia. It is an excellent piece of work, and will well repay the study of any one who is interested in the subject.

THE PRESIDENT: Next in order is the report of the Committee on Coating of Cast Iron and Steel Pipes," by the Chairman, L. W. Rundlett, Consulting Engineer, St. Paul, Minn.; but I do not think anything has been heard from the Chairman, Mr. Rundlett. Have you heard from him, Mr. Benzenberg?

MR. BENZENBERG: No.

THE PRESIDENT: The next on our program is "Report of the Committee on Municipal Franchises." Mr. Saunders is on this Committee, but he is not at present in the room. Mr. McMath, do you know anything about a report from the Committee?

MR. McMATH: I believe Mr. Bardol has part of a report which he has not had time to complete. I came here with the expectation that the Committee would meet together and prepare a report during the time we were in Toronto; but we have not been able to do so, and consequently all that is to be presented in the way of a report is what Mr. Bardol has prepared.

MR. BARDOL: Mr. Saunders, before he left the room, suggested the advisability of having the report held over, allowing us additional time, and having it printed in the proceedings when it is ready.

I do not feel that the report I have is sufficient to have printed. I expected we would meet together with Mr. McMath, after we got here, to get it in shape.

THE PRESIDENT: Do I understand it is not the wish of the Committee to present a report?

MR. BARDOL: Not to-day; but we hope to be able to do so if you will allow us an extension of time.

THE PRESIDENT: Very well, we will let it remain. I do not know whether any action is necessary. Action was taken in the case of Mr. Cappelen, but he was not here. Unless the Convention wishes to take some definite action, I would say the new Executive Committee would be very glad to have the report at as early a date as possible, and have it printed.

REPORT OF COMMITTEE ON MUNICIPAL FRANCHISES.

Your Committee, while realizing that the collection of statistics bearing upon the subject of Municipal Franchises, giving abstracts of conditions imposed upon various corporations seeking grants for the so-called "public necessities," such as water, gas, electric lighting, telephone and street railways, would be exceedingly interesting, hesitated in its undertaking on account of the questionable results to be derived by such an attempt.

Generally speaking, the relationship between corporations having special privileges and the municipality granting them is somewhat similar. Valuable franchises are only too frequently given for the mere asking. At times ordinary business sagacity and honesty on the part of the municipal authorities should indicate the value of the privilege asked for; then again there are instances where private capital is encouraged to invest without immediate prospects of any return on its investment. When prosperous, the results are eventually the same. As a consequence of dissatisfaction among the public, a new company is given a grant, ostensibly to induce competition. This results in duplication of lines and plants, upon which the users and consumers are forced to pay a price sufficient to make a satisfactory return upon the excessive capital invested.

The municipality is responsible to a degree for this excessive bona-fide investment, but its consequence is of small importance compared with the curse of over-capitalization.

The recent reorganization of the four gas companies in Buffalo, N. Y., into one company brought to the attention of the public its large over-capitalization, and, naturally, led to some agitation toward the establishment of a municipal plant. In order to make a comparison between the present condition and what could be expected for works operated by the municipality, the following compilation was made, which may be of interest here:

GENERAL COST OF WORKS.

The capital cost of works is usually spoken of as so much per thousand feet of gas sold or produced. The Board of Trade of the United Kingdom for 1888 shows that on an average of all the gas undertakings the total authorized capital represents 17s, 8⅔d ($5.16) per thousand feet of gas made up.

From the statistics of Capital and Output, given in the Gas Directory of 1890 by E. C. Brown, Editor of the Progressive Age, the capitalization per thousand feet in fifteen of the largest cities was found to be as follows:

New York	$ 6.48
Chicago	13.58
Brooklyn	5.01
St. Louis	19.50 (1)
Baltimore	14.70
San Francisco	11.75
Cincinnati	6.50
New Orleans	20.25
Milwaukee	2.59
Washington	3.25
Jersey City	13.42
Louisville	7.32
Omaha	5.30
Rochester	9.09
St. Paul	9.09
Average capitalization	$9.85

President Hepworth, President of the Incorporated Gas Institute, stated in his address in 1891 that the capitalization of medium and large sized gas works should not exceed $2.75 per thousand.

From the Special Consular Reports, Gas in Foreign Countries, Bureau of Statistics, Department of State, Consul Williams reports, for large-sized gas works the expense in France is from $6.00 to $6.75 per thousand cubic feet. In this expense are included the gas conduits and fixtures for lighting street and public buildings which would represent from 30 to 40 per cent. of the capital.

Recent reports by the Bureau of Labor Statistics of Illinois give the cost of the plant of the Universal Gas Company of Chicago at $1,500,000, having a capacity of 12,000,000 feet per day, and being the largest gas plant in the world. The price of its gas, by ordinance passed July 16th, 1894, is 90 cents per thousand feet.

---

(1) The bonds alone in St. Louis are $9.45 per thousand.

J. Edward Addicks, the famous organizer of gas companies, in an affidavit in an action brought by him in 1887 against the Chicago Gas Light & Coke Company, said: "The sum of $10,000,000 is sufficient to build two gas plants in the city of Chicago, either one of which would be capable of manufacturing all the gas used in said city, constructed according to the most modern methods, and the system of mains, services and meters sufficient to supply every house in the city." The annual consumption at this time was 2,660,000,000 feet, or about four times that of Buffalo.

The Mutual Fuel Gas Company, one of the two companies not in the Chicago trust, organized in 1889, now has a capital stock of $5,000,000, of which $1,500,000 has been issued. Its mains cost $900,000, and plant $600,000. Its capacity is 3,000,000 per day, and during 1896 was 700,000,000.

The annual consumption of gas in Buffalo is about 700,000,000 cubic feet, at a maximum daily of 3,000,000, the amount being equal to the capacity of the Mutual Fuel Gas Company of Chicago, whose plant cost $600,000.

The main item of expense in a plant would be the cost of the distributing system. Experts consider that $8,000 per mile would be required to cover the cost of mains, meters and house connections. In a city covering as large a territory as Buffalo, with a scattering population, it is difficult to say how many miles of mains would be required. Assuming 400 miles, the cost of mains, meters and house connections will be about $3,200,000. The total cost of the works will be $4,000,000, allowing $800,000 for the cost of plant, making a capitalization of $5 71 per thousand feet.

According to recent reports, the capital of the gas combine in this city is $15,000,000, or a capitalization of $21.44 per thousand feet.

Disregarding the cost of the manufacture of the gas, allowing 5 per cent. on the investment, these figures show that with the present consumption, and assuming that its shares are selling at par, the city's interest on its bonds will amount to 28.55 cents, as against $1.07 required by the combine. Since the gas at present is selling for $1.00, this deduction apparently seems unreasonable. Evidently the stocks and bonds are rated below par, but the fact remains that the tendency will be to approach the limit. Of course, as the consumption increases the capitalization per thousand of gas manufactured will decrease.

COST OF MANUFACTURED GAS.

The yield per ton of coal is usually taken at 10,000 cubic feet. Variation in the amount produced affects the value of the residuals, and, therefore, it is not always economical to produce the largest amount of gas.

Assuming the use of Youghioghany Lump at $1.80 per ton, and enriched with 5 per cent. of Cannel Coal at $8.00, equals $0.40 on a basis of one ton of mixture at $2.10 per ton, which will produce at least 9,500 cubic feet.

The residuals from the combustion of one ton of coal, after deducting the coke necessary for the retorts, is as follows:

21 bushels of coke, @ $0.06	$1.26
14 gallons of tar, @ .06	.84
Ammonical products	.50
Total, say	$2.60 per ton

so that the sale from the residuals from the carbonization of a ton of coal nets at least 50 cents per ton of coal carbonized above the price of the coal.

YIELDS AND TESTS OF AMERICAN GAS COALS.

Name of Mine, Coal or Company.	Yield per ton.	Yield per lb.	Candle Power.	Where or by Whom Tested.
Montauk, Taylor Co.	11,693	5.22	16.11	Profs. Rickets and Sloan
Straughn	12,300	5.49	14.97	Profs. Rickets and Sloan
Utopia	12,960	5.78	15.96	Profs. Rickets and Sloan
Blacksburg	13,020	5.72	16.75	Profs. Rickets and Sloan
Coal Valley	11,520	5.14	16.00	Profs. Rickets and Sloan
Upper Creek	12,340	5.50	16.37	Profs. Rickets and Sloan
Cannelton Cannel	12,510	5.58	36.55	Wallace, of Glasgow
Monongahela	11,648	5.20	15.00	Phila. Gas Works
Murphy Run	11,390	5.08	18.95	Manhattan Gas Works
Penn	12,067	5.38	15.05	Nassau Gas Works
Youghiogheny	12,215	5.45	14.47	Nassau Gas Works
Old Virginia	10,414	4.64	13.28	Nassau Gas Works
Blacksburg	11,787	5.26	15.12	Nassau Gas Works
Westmoreland	11,883	5.30	14.19	Nassau Gas Works
Taylor County	12,563	5.60	16.33	Nassau Gas Works
Taylor County	11,066	4.93	18.01	Phila. Gas Works
Cannelton Cannel	12,000	5.31	37.00	Manhattan Gas Works
Black Ridge Cannel	13,938	6.22	55.25	Manhattan Gas Works
Youghiogheny	11,621	5.14	15.61	Nassau Gas Works

A ton of caking coal, properly carbonized, produces about 11,200 cubic feet of 16

Candles gas, equals	375 lbs.
Tar, equals	101 lbs.
Liquor, equals	110 lbs.
Sulphuretted hydrogen, equals	7 lbs.
Carbonic Acid Gas, equals	31 lbs.
Ammonia	2½ lbs.
Coke, equals	1,560 lbs.
Waste	53½ lbs.
	2,240 lbs.

It is difficult to analyze the cost of gas in the holder, but, from a source considered reliable, it is between 20 and 25 cents per thousand feet. Assuming 20 cents as the cost of distribution, which will include the repairs of mains, inspection of meters and clerical force, brings the total cost of the gas, exclusive of capitalization, at 45 cents per thousand feet. This result was arrived at previous to the publication of the report of the Chicago Commission. It is mentioned in the report, according to the undisputed affidavit of Mr. Ketchum, former employee of the Gas Company, the cost in the holder for the Equitable Gas Company was 27.9 cents for 593,688,000 feet made in 1892. Distribution expenses and taxes for various companies month after month is from 10 to 15 cents, making the maximum cost of 24-candle power gas about 42 cents, aside from depreciation and profit, with oil at 2 to 2½ cents per gallon and anthracite coal from $4.00 to $4.60 per ton.

Accepting the Chicago Gas Light & Coke Company's own figures, allowing 10 cents per thousand cubic feet for depreciation, the cost in 1893 would be 48 cents per thousand feet in the burner.

The People's Gas Light & Coke Company officially gave the entire cost of gas manufactured and distributed in 1892, including taxes, as 43 cents per thousand. The report concludes: "Every evidence seems to indicate that in Chicago all charges for gas above 50 cents, and possibly above 45 cents, are profits."

The Cicero Gas Company, a small plant operated in the suburb of Chicago, manufactures gas, the entire expense of which, including taxes, was 54 cents per thousand in 1896.

These figures seem to indicate that with a consumption of 700,000,000 cubic feet per annum, allowing $4,000,000 for the cost of the plant, gas can be manufactured in Buffalo for about 50 cents, plus 28½ cents, equals 78.5 cents—say 80 cents per thousand cubic feet—with a fair profit to the city.

STREET RAILWAYS.

Before 1891 a system of transfers was in use in Buffalo, N. Y., by which a passenger, finding it necessary to transfer from one line to another, was compelled to pay an additional fare of 3 cents.

The city's proportion of the receipts varied from nothing on most lines to as high as 41 per cent. on one line. By universal consent the system of transfers was abolished, and a schedule enacted by which the railway company pays the city 2 per cent. annually of its gross receipts up to $1,500,000; 2½ per cent. over $1,500,000 and under $2,000,000; 3 per cent. over $2,000,000. The amount paid the city in 1898 was $46,000.

There are a number of separate grants, although they now all operate under one management.

EXTRACT FROM THE CITY OF TORONTO, CANADA, AGREEMENT.

The said purchasers and their aforesaids covenant as aforesaid with the said Corporation that they will pay to the said Corporation the said sum of $378,788, being the balance of the said award, in four equal quarterly payments on the first days of December, March, June and September next, or the first juridical day thereafter respectively, with interest at the rate of 5 per cent. per annum from the date of this agreement on the amount thereof then remaining unpaid.

And that they will yearly and every year during the term covered by this agreement pay to the Corporation, through its City Treasurer, the sum of $800 per annum per mile of single track, or $1,600 per mile of double track, occupied by the rails of the said railway, within the said limits (not including turnouts, the length of which are to be approved of by the City Engineer), in four equal quarterly installments, on the first days of January, April, July and October in each year, or on the first juridical day thereafter respectively, the first installment to be the proportionate part of the quarterly installment accruing from the date of these presents to the first day of October next.

And that they will monthly, and every month during the term covered by this agreement, on the first Monday of each month pay to the Corporation, through its City Treasurer, the percentages in the said Conditions and Tender referred to, being the following percentages of the gross receipts from passenger fares, freight, express and mail rates, and all other sources of revenue derived from the traffic obtained by the operation of the said railways, namely:

On all gross receipts up to $1,000,000 per annum, 8 per cent.
Between $1,000,000 and 1,500,000 per annum, 10 per cent.
Between 1,500,000 and 2,000,000 per annum, 12 per cent.
Between 2,000,000 and 3,000,000 per annum, 15 per cent.
And on all gross receipts over 3,000,000 per annum, 20 per cent.

And it is further understood, declared and agreed between the parties to these presents that, should the Corporation within a reasonable time eliminate from Clause 31 of the said Conditions the provision requiring a class of tickets to be sold at the rate of eight tickets for 25 cents for use during certain specified hours of the day, then and in that event the said Purchasers, for themselves, their executors, administrators and assigns covenant, promise and agree with the Corporation and their successors that they will, in accordance with their said tender in that behalf, pay to the Corporation and its successors during the unexpired period of the said term covered by this agreement two (2) per cent. of the said gross receipts in addition to the percentages hereinbefore mentioned, such additional percentage to be payable monthly as aforesaid.

DAY CARS.

Day cars are to commence running on all routes not later than 5:30 a. m., and to run until 12 o'clock midnight, at such intervals as the City Engineer, with the approval of the City Council, may from time to time determine.

NIGHT CARS.

Night cars shall be run on such routes and at such hours and intervals as may be deemed necessary by the City Engineer and approved by the City Council.

TICKETS AND FARES.

Single (cash) fares are to be 5 cents each.

Fares on night cars are to be double the ordinary maximum single fare rates.

A class of tickets must be sold at the rate of 8 for 25 cents, the same to be used only by passengers entering the cars between the time the day cars commence running and 8 a. m., and between 5 and 6:30 p. m.

A class of tickets must be sold at the rate of twenty-five for $1, and another class at the rate of six for 25 cents.

Children under nine years of age, and not in arms, are to be carried at half fare rates, and infants in arms are to be carried free; school children are to have school tickets at the rate of 10 for 25 cents, only to be used between 8 a. m. and 5 p. m., and not on Saturdays.

The payment of a fare shall entitle the passenger to a continuous ride from any point on said railway to any point on a main line or branch of said railway within the city limits; and to enable this service to be carried out, transfer arrangements must be made by the purchaser to meet with the approval of the City Engineer and the endorsation of the Council.

Police Constables in uniform, Detective Police Officers in the employ of the city, and (while a fire is in progress) members of the City Fire Department in uniform, shall be carried free.

The purchaser shall be liable to, and shall indemnify the city against all damages arising out of the construction or operation of the said railway system.

CARS.

Cars are to be of the most approved design for service and comfort, including heating, lighting, signal appliance, numbers and route boards, They must be kept clean inside and out, and shall not exhibit advertisements outside unless under permit from the City Engineer. The platforms must be provided with gates. Cars are to be used exclusively for the conveyance of passengers, unless otherwise permitted by the City Engineer; and smoking will only be allowed on the front platform of closed cars, and rear seat and platform of open cars.

CONDUCTORS.

Each car is to be in charge of a uniformed conductor, who shall clearly announce the names of cross streets as the cars reach them. Conductors shall not permit ladies or children to enter or leave the cars while the cars are in motion, and shall only receive and discharge passengers on right or curb side of vehicle on doubletrack routes. On branch or light suburban lines, where horse power is permitted, single horse cars may be run in charge of a uniformed driver.

Cars are not to be overcrowded (a comfortable number of passengers for each class of cars to be determined by the City Engineer, and approved by the City Council).

FRANCHISE TO ELECTRIC LIGHT COMPANY.

The Power Company in Buffalo pays 2 per cent. of the gross receipts on all electricity sold for heating, lighting and power purposes, excluding the first six years from the date of grant, December 2d, 1885. The grant is for thirty-six years. Provision is made that at the expiration of eighteen years there shall be a readjustment of the percentages to be paid by the Company to the city. The same to be made by three arbitrators, one to be appointed by the Company and one by the Mayor of the city, these to chose a third. Such arbitrators shall have full power to increase or decrease the percentage to be paid, and to otherwise regulate and adjust the same. Their determination shall be final.

The grant provides that the Company must make a verified monthly statement to the Comptroller of the city, showing the gross amount of receipts. The books, records and contracts of the Company shall be open to the inspection of such Comptroller for the purpose of ascertaining the correctness of the report.

The Company gives a bond for $250,000 for excavation and to not unnecessarily obstruct the streets, and fully protects the city against all accidents growing or arising out of not protecting properly their obstructions or excavations.

The remainder of the companies in Buffalo having permission to lay in conduits in streets are required by their grants to make provision for city wires, such as police and fire. Others are required to make them twice the size of present requirements; and then again several provide for the use of conduits by foreign companies, after a determination by a Board of Arbitration as to the amount to be paid for such use.

To the one characteristic which corporations have of stock watering may be attributed most of the dissatisfaction arising from franchises given to corporations. Whether its final solution will be municipal ownership or the rigid control by the government over private corporations is an open question. But the prerequisite of any remedy is the need of active participation on the part of intelligent voters in the affairs of the municipality.

Satisfactory results from franchises given to private corporations can be had only when capital is satisfied with a reasonable return on its actual investment, and is willing to have the affairs of the company open to inspection and regulation of a competent and responsible body appointed by the municipality. A grant specifying the maximum dividend the Company is to derive on the capital invested, and, as an incentive to economical management, allowing an additional percentage dependent upon the amount of net earnings, would be all that could be desired.

Success in municipal ownership or under municipal control can be had only by the organization of a body entirely independent of political influences. With the merit system, wisely framed, honestly enforced, and earnestly supported by the public, there is no reason why any of the enterprises now operating by virtue of special privileges cannot be successfully managed by the municipality.

BERNARD SAUNDERS, Chairman.
FRANK V. E. BARDOL.

THE PRESIDENT: If there is nothing further to be said on this question, we are ready for the report of the Committee on Review.

MR. BENZENBERG: As this report of the Committee has nothing in it to bring out any discussion, and as the report may not to many be of great interest, it seems to me it would be well to move that it be simply received and printed with the proceedings.

THE PRESIDENT: You have heard the suggestion from the Chairman of the Committee; but I would like to say that Mr. Benzenberg's last report was an extremely interesting one. I do not know that I heard it read, but I have read it several times since with a good deal of interest.

MR. SHERRERD: Can Mr. Benzenberg give us a sort of synopsis of the work of the Committee without reading the report.

MR. BENZENBERG: Yes, I can skip some parts and read the balance. The report in itself is a synopsis of other municipal reports.

TO THE PRESIDENT AND MEMBERS OF THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.

GENTLEMEN:

Your Committee on Review, instead of following the method adopted last year of obtaining data for their report by correspondence, have confined themselves to a review of the municipal reports so far as such were issued and obtainable. It was learned that in quite a few cities no report upon any improvements or municipal work was either prepared or submitted, while in many other cities such reports were submitted but not printed nor distributed.

The members of the Committee have received sixty-seven different reports from as many municipal departments having charge of public works and improvements, and these have been carefully reviewed for the purpose of presenting to you any new or novel features in the way of methods, material, design or character of work which may have been attempted or introduced in connection with municipal improvements or of any legislation which may have been adopted to assist in executing such work. The reports, however, were so meager as to that class of information that any data of interest has been included in this report, though it may thereby fail to be interesting.

Twenty-four of these reports contain merely tabulated statements of the amount, class and location of work done, of the amount of money received and expended, of total values of the various kinds of improvements, etc., all of which is interesting to the tax payer but not to the members of this Society and hence no mention of such reports is made herein.

The Committee again appeals to the heads of the various municipal departments having charge of public improvements, that in writing their reports they kindly remember that their reports have a value with their colleagues of other cities in proportion as such reports contain interesting descriptions and illustrations of municipal work, especially if they contain new features or are surrounded by difficulties. No matter how little you may be doing, it is instructing to all to know how it is done and why.

As the subjects reported upon cannot well be treated under classified heads, the reports will be taken up in alphabetical order.

The report of the Albany Board of Water Commissioners is made very interesting by a large number of plates showing the different stages of construction, of methods and machinery employed and the progress made upon the new reservoir, sedimentation basins, filter beds and the various lines of piping, etc. Very fair progress seems to have been made and the works were expected to be ready for operation early the past summer. The cost of the work was expected to differ little from the estimate, which was $478,000.00.

The average daily consumption being 164 gallons per capita the general introduction of meters is strongly recommended. The report shows a very material decrease in the actual running expenses of the department for the past four years, and efforts are being made to still further reduce the cost by the introduction of some smoke consuming device which will permit the use of bituminous coal.

According to the report of Baltimore, Md., the days of cobble stone pavements have not yet passed, although the commissioners hope steps will soon be taken to prevent the laying of any more of them. The laying of sheet asphalt on a cobble base is strongly urged.

It is proposed that all openings made in streets be repaired by the city at the expense of the party making the opening so as to secure better repair work.

Ten or fifteen years' guarantee on improved pavements are recommended.

Baltimore has over 300 miles of cobble stone paved streets; 31 miles of granite block pavements; 9½ miles of asphalt block pavements, and 8 miles of sheet asphalt pavements.

Last year vitrified brick gutters were laid on asphalt paved streets. A new method of contracting for street pavements hereafter is suggested in that price of pavements be fixed by the city, and that the contractors compete on the time they will agree to maintain the pavement, the specifications being explicit as to the condition of the pavement at the end of the guarantee period.

Wide tires on vehicles are urged as necessary to the maintenance of roadway pavements.

In constructing a 10.5 feet diameter sewer, the work was divided into sections and worked alternately to give the arches time to set before drawing centers.

In the City Engineer's report of Binghamton, N. Y., it is claimed that $10,584.99 was saved by the city by building sewers by the day instead of by contract since 1896. The total cost of sewers built by the day was $32,539.65, the city paying $1.50 per day for labor while the contractor's price was $1.10 per day.

The superintendent of the Brookline, Mass., Water Board, reports that the cement lined iron pipes after a service of 25 years are free from any interior obstructions, and, where taken up, due to sewer construction or change in street grades, they were found as smooth and perfect on the inside as when laid 25 years ago. From a sanitary point of view he claims no better pipe can be desired. He also dwells upon the excellency of the water and as a refutation to the charge that its hardness causes and aggravates rheumatism, gives a table showing the hardness of different waters supplied from springs and other sources throughout the State, some of which range from six to twelve degrees of hardness.

The Water Commissioner's report, of Burlington, Vt., shows that the average daily consumption for the last year was 805,800 gallons. It mentions the fact that during a lumber yard conflagration nine hydrants were in use and that about six million gallons of water was used. The above is given as an excellent test of the works to maintain good pressure during the time of heavy draft.

Forty-six per cent. of the water pumped is metered and yields seventy-four per cent of the revenue. The average daily consumption is forty-five gallons per capita per day.

The Water Board of Cambridge, Mass., in its report rejoices in the statement that the completion of Hobbs Brook storage basin secures to the city with its other basins such an ample supply of water that no matter what other cities or towns may need regarding the Metropolitan water supply, Cambridge will not need any other source of supply than Stony Brook for a generation to come. It also reports a very satisfactory financial condition of the department.

The report of the Department of Public Works of Chicago, as usual is very complete and cannot well receive exhaustive review for want of space. The department of electricity reports 2,923 arc lamps in service and claims the distinction of having the largest municipal street lighting plant in the world. The total annual cost per lamp is given at $68.50, which, through proposed improvements, it is expected during the present year will be reduced to below $60.00.

A department of supplies was established so as to insure the purchase of all supplies in a way to secure value received for all sums expended. Requisitions are made upon the Business Agent by all heads of departments and he purchases the supplies in quantities to effect a considerable saving, stocking such supplies as are in regular and constant use in a warehouse maintained for that purpose. During the year 16,327 orders were issued and over $694,000.00 were expended by the department.

The Bureau of Streets reports laying nineteen miles of cedar block pavements, nine miles of asphalt, six miles of madacam, two miles of brick and one mile of granite block pavement. An appropriation of $150,000.00 for street repairs was sufficient to cover but one and one-half per cent. of the cedar block pavement in the city, while between seventy and eighty per cent. of the various kinds of pavements need immediate repair.

The total mileage of streets and alleys cleaned was 19,000 miles at a cost of about $157,000.00, while 450 miles of sidewalks were inspected and condemned and 253 miles of new sidewalk were built by the city and 201,957 loads of garbage and ashes were removed to the dumps by the department men, no satisfactory plan for the disposal of garbage having yet been effected.

The Bureau of Sewers reports that considerable progress has been made upon the intercepting sewer system and that at least forty per cent. of the sewage which had polluted Lake Michigan is now discharged into the Illinois and Michigan canal until the drainage canal shall have been put into operation, when it will take all the sewage, to be discharged in a diluted form into the Illinois river.

Over forty-eight miles of new sewer were constructed and 1,388 miles of sewer were cleaned and kept in repair.

The Water Bureau reports a thorough overhauling of the machinery at the various pumping stations which resulted in better service. About 17,000 new pump valves replaced as many defective ones and 24 boilers were retubed and otherwise repaired with the result that over 2,746 million gallons more water was pumped than during the previous year at an expense of over $22,000,00. less for fuel. Over 34,000 tons of cast iron water pipe were laid during the year. The new water tunnel system is reported as nearing completion, the lake end, which is 10 feet in diameter and 14,108 feet long, being finished. When this work is completed the total actual tunnel capacity will be 418,000,000 gallons per day. Thirteen per cent. of the water pumped is reported as being metered and as paying thirty-one per cent. of the total revenue, which is $3,489,390.00, and this fact is used as an argument to favor the general introduction of meters. The average daily consumption per capita was about 150 gallons.

Great progress in work of elevating track crossings is reported. Some 96 grade crossings were eliminated at an expenditure of over $6,650,000.00, giving employment to fully 40,000 men. This work is expected to be completed during the present year.

These reports are all so elaborate and full of interesting data regarding the construction of the tunnels, intercepting sewers and track crossings, fully illustrated by plates, that this should be read complete and therefore your Committee refer you to the reports themselves for further information.

The department reports of Cleveland, O., show that 7,877 feet of the new water works tunnel was completed during the year 1898, and that two explosions took place in the tunnel which resulted in the death of 19 men. Much difficulty was also experienced in the shaft at the crib.

The report shows that the cost of coal for pumping one million gallons of water was reduced from $2.22 to $1.03, by the completion and operation of the new Allis triple expansion pumping engine.

Much trouble is also reported from electrolysis of water pipes and connections, and stringent legislation is recommended.

There were in use at the end of 1898, 2,151 water meters. The quantity of water supplied through them was 12,158,000 gallons out of a daily pumpage of 51,839,816 gallons.

The cost of cleaning pavements is given as $18.58 per mile, the lowest in the history of the city.

Sixty streets were paved and repaved in 1898, and legislation completed for ninety-six streets to be improved in 1899. A large amount of sewer work was also done in 1898, and plans were prepared for building 105 sewers this year.

Four thousand nine hundred and five feet of electric conduits and subways were completed during last year.

The principal materials used in paving were brick, Medina stone blocks and asphalt. Concrete foundations for brick pavements were used on two streets only, where double street railway tracks confine the traffic to the sides of the roadway.

Paving bricks used are 5 inches deep, 3½ inches wide and 8¾ to 9¼ inches long. Bricks have raised letters on one side only, with a half round recess across each end, to secure a cement joint upon each side of every brick laid and a dowel joint across each end when the pavement is laid and filled, as is the custom in all cases.

Portland cement and sand in equal parts are used to fill joints in stone and brick pavements, but streets must be kept closed from ten to twenty days to allow the cement to fully set.

Asphalt pavements are laid under a ten year guarantee and ten per cent. is retained by the city to the end of the guarantee period.

Stone pavements are laid under a five year and brick under a three year guarantee, two and one-half cents per square foot being retained by the city until the end of the guarantee term. Contractors are paid interest upon the retained percentages.

A full description is also given of the Walworth Street sewer, which is 16.5 feet in diameter at its lower end and 8 feet in diameter at its upper end and 13,600 feet long, and is constructed of brick and concrete. In order to pass under the railroad tracks near the outlet of this sewer, it was necessary to flatten the same from 16.5 feet diameter to 5 feet in height and about 50 feet width, a slight channel being provided in the bottom for the small dry-weather flow.

Another problem to be met with in the construction of this sewer is the supporting of one of the pedestals of a viaduct under which the same will pass. The grade of one of the streets must also be raised six or more feet.

An overflow chamber 110 feet long, 37 feet wide and 20 feet high, is illustrated, being one of the largest structures of its kind in this country.

The sewer work in Cleveland during the past few years has been and is one of the most important works undertaken by the city, a full description of which is more than can be given in a review of this kind.

For the purification of the river a flushing tunnel nearly three miles long and eighteen feet in diameter is proposed, with propeller wheel pump similar to the one so successfully used in Milwaukee.

Little was done last year on the extension plan of widening the river.

Creosoted plank and paving blocks were used on the east half of Pearl Street viaduct at an increase in cost over the two courses of white oak plank elsewhere laid.

The new Center Street bridge will have its center pier at one side of the river with one arm of the bridge 145 feet and the other 100 feet in length. Latest swing bridges are successfully operated by electric power.

Abolishment of grade crossings at various points is being considered, and a grade crossing commission has been appointed.

Electric conduits have been laid by seven companies.

At the Convention last year a paper by Harold P. Brown, Electrical Engineer, New York, on electrolysis of water pipe, describing the survey and tests made in Dayton, O., was read. As a result of these examinations suits were begun against the railway companies for damages.

Meters are placed on all services put in during this year and it is expected to gradually change this system from assessment to meter rates.

The report of the Detroit Board states, that as a practical test of durability fourteen kinds of brick were laid on one street near the wharfs and depots.

Sidewalk inspectors use bicycles, with good results, to enable them to cover their districts.

The paved streets in the central parts are hand cleaned, except one cleaning per week by machine sweepers. The laborers wear white uniforms. The litter is collected in barrels and left in convenient places for the collectors' wagons. The system is said to be efficient and very satisfactory.

Detroit boasts of the lowest water rates in the world and believes that with careful management that low rates can be maintained. A system of blow-offs was introduced into the pipe system, whereby the deposits of silt could be discharged into the sewers. About 2,000 cubic yards of silt was thus removed and about 100,000,000 gallons of water used for flushing.

The fourth annual report of the Detroit Public Lighting Commission, states that 1,868 arc lights of 2,000 candle power each were used for street lighting and that the cost of operating and maintaining the entire plant had been reduced to 46.46 per light per year, and, allowing three per cent. upon the total investment for depreciation, four per cent. as interest thereon and the regular rate of taxes upon its assessed valuation as lost taxes, all as fixed charges, and the total cost per arc light per year amounts to $75.56.

The report is full of the details of operation of the plant, the total cost of which has reached $813,803.47.

The Commissioners of Water Works of Erie, report against a reduction of water rates for the present until the most urgent extensions and improvements have been completed and depreciate the wastage of water as shown by the consumption of 108 gallons per capita per day, favoring the introduction of meters.

The Commissioner of Public Works of Evanston, Ill., dwells at length upon the necessity of a purer and greater water supply, to be obtained by either laying an iron pipe five feet in diameter or of building a brick tunnel of six feet in diameter for a distance of one mile from shore into 26 feet depth of water. The present intake consists of a 30 inch cast iron pipe laid upon the bottom of the lake for a distance of 2,600 feet from shore in 20 feet of water. An examination of this pipe is reported to have shown 21 open joints.

The City Engineer reports that the tops of fire hydrants are and have been always used as bench marks and that it is neither wise nor safe to do so, that a strict adherence to the specifications for sewer improvements whose dates vary by a year or more would cause some branch sewers, for example, to start at a lower level than the bottom of the main sewers into which they are to empty, which is not due to error or carelessness of the engineer but due to the alterations made at the hydrants without his knowledge.

The Water Board of Fall River, Mass., reports that the water is examined by the State Board of Health each month. Total number of services are 6,576 and of meters 6,128. The daily consumption of water per capita, 33 gallons. With this large proportion of water supply metered a table and diagram is reported showing that, allowing five per cent. loss on registration of meters, but 54.4 per cent. of the water pumped is metered, that about 27.3 per cent. of the water pumped is unaccounted for, that 14.3 per cent. is used for public purposes, while 4 per cent. is supplied to consumers, though not metered. Vigorous measures are being taken to locate this waste of water.

The City Engineer urges new laws for laying out streets by which streets shall be laid out with some attention to the needs of the people who will have to use them, and avoid expensive changes in the future.

Fall River is said to have the least amount of street paving of any city of its size in the country.

Plans for abolishing dangerous grade crossings have been prepared, and it is expected work will be pushed this year to carry out the plans.

Electric conduits to the length of 14,314 feet have been laid, by four different companies. Further extensions of the conduit systems is urged.

At Fort Wayne, Ind., the asphalt pavements are let on a ten year guarantee, with a surety company bond.

Electric wires are being placed under ground as fast as permanent street improvements are made.

Garbage is being collected by contractors in city garbage wagons. One contractor, however, cannot have more than one district.

The Hartford, Conn., Water Board dwells upon the necessity of an additional water supply.

The City Engineer of Indianapolis, Ind., reports 406 miles paved with creosoted long-leaf yellow, southern pine blocks, ten pounds of oil being used per cubic foot. While no trouble has been experienced, and none is expected, it is still regarded as an experiment, and it is recommended that the Board do not lay that class of pavement to the exclusion of other well established kinds of pavements.

Blocks were laid diagonally across the street, expansion joints made along the gutter line and at intervals across the street.

In asphalt pavements only Trinidad Pitch Lake and Bermudez asphalts are allowed to be used.

Attention is called to the fact that it is even more important from a sanitary point of view to pave alleys than it is to pave streets.

A proposition was made by the private water company supplying the city to sell its plant to the city, but after a thorough investigation by Mr. John W. Hill, of Cincinnati, O., and the City Engineer, the proposition was rejected, and a new contract with the company was recommended.

Over 1,000 acres of land were purchased for park purposes. The superintendent of parks gives a very interesting report of the work to be done in the improvement of these lands for park purposes. The best trees for planting in parks is a good supplement to the paper read at the last Convention on trees for city streets.

The establishment of Central Park in New York City in 1858, is given as the first step in this country taken by any city to secure a good sized park.

Instead of the ordinary franchise for the construction and operation of a telephone system, the Board of Public Works entered into a contract with the telephone company for the construction of a telephone system, the company giving bonds for the faithful performance of their work and for the annual payment to the city of $6,000.00 for the use of the streets, lanes and alleys, with provision for an additional payment when more than 6,000 'phones are in use. This contract was confirmed by ordinance of the Council.

The City Engineer of La Crosse, Wis., reports that the first cement gutters, three feet in width, were laid, and is strongly impressed with their great advantage and advises their use on all macadamized streets. The cost is given as about eighty-five cents per lineal foot, which must include a stone curb. No description of this gutter is given.

The City Engineer of Little Falls, N. Y., reports upon the various water, sewer and street work, as being maintained in good and satisfactory condition. The cemetery as well as the parks seem to be owned by the city and the report mentions that the system requiring all payments, either for interments or work, to be made in advance has been quite satisfactory as well as the new regulation that makes it a condition precedent that before any burial permits are issued, all back taxes be paid up. Think of the tax gatherer meeting you at the brink of the grave.

The Public Water Board of Lynn, Mass., report that the last of the cement-lined pipe have been replaced with cast iron pipe.

The Water Commissioners of Melrose, Mass., report frequent breaks in the cement-lined pipes, many of which have been in use for nearly thirty years, which necessitates their speedy removal and replacement with cast iron pipes.

The Board of Sewer Commissioners are authorized upon written request within three months after notification of a sewer assessment of any owner of an estate assessed to divide the amount into as many equal parts (not exceeding ten) as the owner may desire, interest at the rate of five per cent. on unpaid parts being added to the amount. The Commissioners may abate the whole assessment, or any payment, upon complaint of the owner of an estate assessed, such abatement to remain a lien upon the property until paid,

The Middleton, Conn., Water Board reports that water from Laurel Brook reservoir is so badly tainted with vegetable flavor seven months of the year that it is not fit for use and this is due to the profuse vegetable growth over the bottom, which, before it was overflowed, was a swamp from which the surface soil has not been removed. It also reports the completion of the Higby Mountain reservoir of about eighty and one-half acres.

The Milwaukee report by a table shows how during the past nineteen years an increase in the number of metered water services produced a very material decrease in the consumption of water per tap, the water pumped during last year being four per cent. less than was delivered in 1891, while the number of taps were 35,994 and 18,838 respectively.

It also reports a readjustment of the water rates, the meter rates being flat at six cents per one thousand gallons for whatever quantity may be used with a charge of one dollar per annum for reading the meters, the meters all belonging to the consumers. It is stated that under the new meter rates, based upon the past year's individual consumption, over 12,000 metered consumers will not pay over two dollars per year and about half of these will not pay over one dollar per year for water aside from the charge for reading meters.

Report is made for the construction of another flushing tunnel of twelve feet diameter for flushing the Kinnickinnic, a river running through the southern part of the city and extremely foul from factory wastes and sewage.

The City Engineer of Minneapolis reports replacing cedar block pavement in alleys by either a brick, sandstone or granite block pavement with asphalt filler. He reports receiving bids under ten different conditions for paving certain streets with brick, all of which were finally rejected and he was directed to purchase all necessary material and lay the pavement by day labor. The brick was purchased under a ten year guarantee, sand filler was used and the pavement cost about $1.60 per square yard.

The first sandstone street pavement in the city was laid with Kettle River sandstone on sand foundation and asphaltic filler at $1.725 per square yard.

Bids for asphalt pavement were also received under five separate conditions, all of which were rejected and bids again received under a ten year guarantee with brick or sandstone gutters and a price per square yard for keeping the asphalt pavement in repair for a second ten year period. The contract was awarded at the following prices per square yard: $2.15 for the asphalt pavement, $2.10 for brick gutter and ten cents per year for second period of ten years, standard California asphalt being used.

A very large amount of sewer work is recommended as extremely necessary.

The City Council granted several franchises to telephone companies. In the first case the city reserves the right to purchase any time after five years from date of acceptance of franchise the entire system within the city limits of the city at actual cost of construction less depreciation and no value to be placed upon the franchise. In the second case the city reserves the same right any time after four years from date of acceptance and also limits the charges for telephone service for business purposes at $48.00, if located within two miles of the United States Post-Office and for residence telephone at $30.00 per annum, if located within the city limits, and $3.00 additional for each half mile any business telephone is located beyond said two mile limit. In addition thereto each company is to pay five per cent. of its gross earnings into the city treasury.

The Nashville report speaks of the difficulty encountered through high stages of water in the river in and during the construction and extension of an island water filter which consists of a brick conduit six feet in diameter having three inch clay pipes built in the walls to collect the filtered water. This conduit is constructed upon an island at a depth of from 18 to 24 feet below its surface, the trench being refilled with broken stone.

The superintendent of the Norfolk, Va., Water Board reports numerous improvements and extensions under way, among which may be mentioned the installation of a six million gallons mechanical filtration plant, preference having been given the mechanical filter solely upon the question of first cost. In connection with this and other extensions he urgently dwells upon the necessity of introducing meters to check the great waste of water and to support his argument quotes liberally from the reports of many other cities. The report is interesting.

The New Orleans Water Works report mentions at length the proceedings commenced by the Attorney General of the State under the direction of the Legislature of Louisiana, for the forfeiture of the Charter of the Water Company, notwithstanding the city of New Orleans owns one-fifth of the stock of said company and has a representation of three upon a Board of seven Directors. The principal reasons for forfeiture are given as failure to supply pure water and of furnishing an adequate amount for fire purposes and of charging excessive and unequal rates, all of which is denied in the answers. The report also mentions the freezing of a large number of yard hydrants last winter.

The Water Board of New Bedford, Mass., reports that the work on the "Further Water Supply" is at last nearly completed. The cement-lined pipe laid in and prior to 1870 has been replaced with cast iron pipe, "the cement-lined pipe having passed its safe life." The condition of the water (a surface supply), is carefully watched, samples being sent each month to the State Board of Health for examination.

The laying of 1,500 feet of submerged six inch pipe with Ward flexible joints, is briefly described.

The City Engineer reports that the grade crossing investigation has been going on since 1894, and is still going on and that plans are practically agreed upon for abolishing a portion of the crossings by elevating the tracks.

Plans have also been prepared for an intercepting sewer system. The engineering department is organized as a separate department and does work for the other departments of the city, as indicated in the Engineer's report, as follows: Public Works; Park Commissioners; Board of Assessors; Cemetery Board; Water Works Department; Superintendent Public Buildings; City Solicitor; Street Railway Company; Private Parties; Grade Crossing Commission; Board of Health, etc. (A general description of the relation of this department to the other departments of the city would be interesting).

For Newburgh, N. Y., a report is made by John D. Van Buren, Consulting Engineer, and Everett Garrison, Engineer of Construction, on an additional supply of water.

Examinations for electrolysis in water pipe was also made, resulting in finding several places where pipe was being damaged by the action of the electric current.

The City Engineer of Newton calls attention to the advisability of obtaining authority to regulate the laying out of streets in Newton, property owners developing their property without reference to the adjoining owners, which causes short detached streets in every plat throughout the city to the detriment of all adjoining property.

Considerable work is reported as having been done in widening and improving a number of highways and on abolishing grade crossings, the full reports upon the latter subject being included in the last annual report.

One of the conditions under which street railway privileges are granted provides that the street railway company shall so provide for its electric currents and provide such conductors thereof and of return currents that avoidable injury or detriment shall not occur nor be done to water or gas pipes or any other property, and that said company shall pay all damages by reason of failure to keep or perform this provision.

The City Engineer of Pawtucket, Mass., reports 7,914 water services in use and 5,942 of them metered. He also reports the sewage filter fields in successful operation throughout the year. The application has been at the rate of 80,000 gallons per acre for the sludge beds and 100,000 gallons per acre for the others.

The report from Peoria, Ill., states that only two streets were paved and that not a foot of sewer was built. The new city hall was completed during the year, and cost $224,907.45.

To the application of a new law, with its complicated proceedings, and the consequent opportunities to delay the improvements by trivial objections, and the division of jurisdiction between the Board of Local Improvements, the Board of Aldermen and the County or Circuit Court, is attributed the reason for so little new work having been done.

Expansion cuts at intervals of 50 feet in the asphalt pavement surfaces are reported as being desirable.

The Philadelphia report states that after much litigation the Loan Bill, by which the city is enabled to borrow money for needed public improvements, was passed, and investigations are now in progress for a new or purer water supply.

Philadelphia, with 7,147 electric lights in its highways, claims to be the best lighted city on this continent. In addition to the above electric lights there are 34,417 gas and gasoline lamps in use.

The abolishment of grade crossings has received much attention, and plans and estimates prepared for much gigantic work along the lines of several railroads, much of which work is well under way.

The Pennsylvania Avenue Subway and Tunnel was nearly completed last year. This is described as one of the greatest engineering works undertaken by any city, and consists in depressing the tracks and yards of the Philadelphia & Reading Railroad. The tunnel is 2,711 feet between portals, is 52 feet wide, except 45 feet, which is 58 feet wide. More than 50 contracts were entered into for various parts of the work.

Another piece of work of considerable magnitude, and which is well advanced, is the widening of Delaware avenue from 50 to 150 feet in width, by reclaiming 100 feet of the river, the water being from 4 to 20 feet deep, under which is soft mud from 10 to 40 feet deep. The extension of sewers to the new bulk head line, and the construction of a stable foundation upon which to make a street, is no small task, and presents many difficulties and interesting problems. Blocks of concrete weighing 32 tons were used in the bulkhead wall.

While the estimated cost of the improvements is not given, the total amount available for the work is $2,150,000.00.

The city has a very complete testing laboratory for testing all materials used in construction.

Tests of the various paints for iron and steel have been made by exposing sample plates to the fumes of locomotives passing under one of the bridges. The results have not been sufficiently conclusive to warrant the department in changing its practice of using pure red lead and linseed oil.

The Chief of the Water Bureau calls repeated attention to the very bad condition of much of the water works plant, and the very poor quality of the water supply during a large part of the year. He recommends the expenditure of one million dollars for meters to check the reckless waste, of the same amount of money upon the existing works to remedy defects and develop their full efficiency, and of $1,200,000.00 for the installation of a filtration plant for part of the supply.

The new city charter of Portland, Oregon, provides that a Board of Public Works shall have charge of all public improvements.

Brick pavements on several streets have recently been constructed, and they are regarded as an experiment.

The common width of streets is 60 feet, with 36 feet roadway. Narrow roadways are recommended as being cheaper to construct and maintain.

Concrete foundations for pavement are strongly urged.

The annual report of the City Engineer of Providence contains a number of photographic plates. Two show a method of melting out the lead joints of a line of 24 inch cast iron water pipe by means of the "Wells light" which has been used with great success during the past year. Kerosine oil was used under an air pressure of about 25 pounds and each joint was melted out in about an hour with about two gallons of oil.

Another plate shows the amount of tuberculation which had taken place on the interior face of the 24 inch tar coated cast iron water pipe after about 25 years service. As shown the pipe was so very thickly coated with tubercles that they must have considerably reduced the conveying capacity of these pipes. The report also mentions the progress made upon the Improved Sewerage System accompanied by plates, one of which shows the construction of a section of this sewer in the bed of a river. The total amount of sewage pumped during the year was 4,974,129,807 gallons at a total cost of $2.52 per million gallons pumped. The report also contains a very interesting view and report of the new Weybosset bridge which has a surface area of 31,610 square feet without any part of the structure in view above the sidewalk or roadway surface.

The superintendent of the Richmond, Va., Water Works makes a very good showing in decreased consumption, increased revenue, increased pressure and increase in reserve capacity as a result of the introduction of meters.

The Reading, Pa., Water Board reports a number of breaks in the main, among them the blowing out of a wooden plug from an unknown and unrecorded six inch branch pipe which caused damages to private property to the amount of $13,000.00. In connection therewith they state that there is no record of any specials that have been put along the line of water pipes laid in former years and that the location of many branches plugged with wood, laid under former administrations, are to-day unknown.

The city of Rockford, Ill., owns its stone quarry and also a new first-class, fully equipped stone crushing plant at the quarry. The rock is drilled by an Ingersoll-Sergeant steam drill, and after blasting, is hauled by cable to the crushers. It is screened in three sizes and dumps 1½ yard at a time from separate bins into the wagons below. There were 17,880 yards of stone crushed at an average cost of 29 cents per yard. The new crushing plant cost $5,769.62 and caused a saving during the first year as against the old crusher of $6,436.80. Four miles of street were macadamized.

At Sandusky, O., the great need of the water works, according to the Engineer's report, is an additional pumping engine.

The red lead paint applied to the interior of the stand-pipe in 1892, was found to have entirely disappeared, and the plates to have been badly corroded, with pits covering almost the entire surface. These pits varied from 1-32 inch to 3-16 inch deep.

Dispensing with direct pressure pumping is recommended by the superintendent, as it is hard on the main; is liable to start the lead joints, and cause them to leak.

The South Bend, Ind., Water Works, reports nearly six miles of wood pipe in use for over 20 years. There are, however, so many leaks, that its speedy removal is recommended.

In no case will any meter be maintained for less than $1 per month. A discount of five per cent. allowed on meter bills paid before the 10th of the month.

The Water Commissioners of Springfield, Mass., report that the most serious problem they have to contend with is the continued growth of algae in the Ludlow reservoir. Arrangements have been made for a temporary supply while the reservoir is being drained, examined and cleaned.

The City Engineer reports a very considerable amount of sewer construction work under way and the preparing of plans for both separate and storm water sewers in new territories.

The abolishing of all grade crossings has been considered, and plans have been prepared to eliminate certain crossings and to make such alterations in the sewer system as may become necessary by such changes.

The Trustees of Water Works at Toledo, O., in their report appeal to the Council for a pure water supply.

The Engineering Department of Wheeling, W. Va., having been recently organized as a separate Department, the Engineer in this report has given a brief historical and statistical table relating to the city.

He claims that Wheeling was one of the first cities in America to use brick for street paving, and he regards it as the best material for the city to use where the grades are not too steep.

The city buys its brick, and has them inspected at the kilns. Concrete foundations are recommended for the business streets. Gravel and broken stone, rolled with a seventeen ton steam roller, being the foundations in use at present.

Curved curbs at street and alley intersections are mentioned as an innovation,—a curve of 6 feet radius,—one street being especially mentioned.

The report is largely taken up with recommendations for future work, rather than descriptions of work performed.

The superintendent of sewers of Wilmington, Del., reports some very interesting experiments determining the carrying capacity of some new lines of terra cotta pipe sewers of 18, 20 and 24 inches diameter. The lines of pipe sewers were very carefully laid, the 18 inch being 3,091 feet long on a grade of 6.5 feet per 1,000, the 20 inch being 2,106 feet long and laid on a grade of 6 feet per 1,000, while the 24 inch is 6,952 feet long and laid on a grade of 8 feet per 1,000 feet. Having an opportunity to flow into the upper end of this sewer whatever amount of water was desired, suitable light cork floats were prepared to indicate the velocities upon the surface and at mid-depth, which, however, did not differ materially. In the 18 inch pipe it is reported that the velocity was found to be 5.75 per second and the co-efficient of friction as .011, making its carrying capacity 10 cubic feet per second, whereas the calculated values were respectively 4.0, .015 and 7. The velocity of the 20 inch pipe was found to be 6.8 feet and the co-efficient of friction .01, while the velocity in the 24 inch pipe is reported as having been 12.47 feet per second, the co-efficient of friction .0075 as against 5.47 feet the calculated velocity and .015 as the co-efficient.

In Youngstown, O., old brick pavements are covered with asphalt. The brick pavement is thoroughly swept and washed clean and, after it is dry, it is heated with surafec heaters, which destroys all combustible matter and completely dries out the brick. While they are still warm the surface of the brick is painted with a thin coat of asphalt applied with brushes. If the holes and depressions in the old pavement are deep, they are filled with broken stone mixed with asphaltic cement and if shallow they are filled with the same material as the surface coat and thoroughly tamped. On this the surface coat is placed in the usual manner. This is said to give perfect service.

A garbage crematory has been constructed for the city at a cost of $12,300.00.

In conclusion your Committee wish to state that the reports from some of the larger cities could not be obtained by them, though they were applied for, and hence the Committee has not been able to report upon them.

G. H. BENZENBERG,
GEO. M. AMES,
M. B. HOWE,
Committee on Review.

THE PRESIDENT: I feel sure that Mr. Benzenberg and his Committee have done something that will save many of us a lot of work when we want to lay our hands on this kind of information. I do not know that I have seen a synopsis of important features of municipal work put in such convenient shape before. It would take a vast amount of search and trouble to acquire this information, and I have no doubt you will very frequently refer to and consult this report.

This finishes the printed program; and any general business may now come before the Society.

MR. BALL: Mr. President, I deem it of sufficient importance to call the attention of the Convention to a fact which I have just ascertained, respecting the use of main traps—a subject which was considered the other day. I find, among the other examples of advanced municipal methods which prevail in Toronto, that their plumbing regulations. distinctly recognize this method of construction in one class of cases. It is usual in Toronto to construct a terra-cotta drain from the house to the sewer, but in order to encourage the use of an iron substitute for that portion of terra-cotta their regulation authorizes the omission of the trap and fresh-air inlet in the house sewer if it be made continuous and terra-cotta omitted—a notable example, to my mind, to the three which were noted in the paper.

THE PRESIDENT: Gentlemen, I think it might be of interest to you to read an extract from an editorial from one of the New York papers of the day before yesterday, which has been received by me to-day. It says: "The Toronto Convention, to-day, of "the American Society of Municipal Governments, deserves more "attention than in the exhaustion of Dewey days and the stimulus "of the international yacht races it will receive. In the millennium "there will be no politics in public works, education, transportation, street construction and cleaning; and in the meantime "comparisons of the methods in which municipalities, absorbing constantly more and more of the world's population, may best "be administered, demand not partisan prejudice and the hungry "zest of the spoilsmen, but intelligent judgment of trained specialists. When one considers that the municipal expenses of two "years would pay the national debt, no apology need be made for "careful study most wisely to expend this vast amount which the "people pay for the mere privilege of living; and societies like that "meeting this week in Toronto have not only reason for being, "but encouragement to press upon the public attention their work "and their results."

I wish to call your attention to the fact that there are three special committees which have been appointed from time to time by resolution of the Society, and the President was in doubt last year whether or not these committees should be continued; but they have never been discharged by the Society. It seems to me that the Committee on the Coating of Cast Iron and Steel Pipes and the Committee on Electrolysis might properly be discharged, and that the Committee on Municipal Data, especially as next year is the Census year, had better be continued.

Moved by Mr. Benzenberg, seconded by Mr. Tillson, that the Committee on the Coating of Cast Iron and Steel Pipes and the Committee on Electrolysis be discharged, and that they be eliminated from the list of committees.

THE PRESIDENT put the motion, and, on a vote having been taken, declared it carried.

MR. BENZENBERG moved, seconded by Mr. McMath, the following resolution:

Resolved, That we regret that Mr. John L. Kennedy, Director of Dept. Public Works, Nashville, Tenn., has informed us that his duties

prevent him from assuming the position of Treasurer for the ensuing year; and further

Resolved, That this Society desires to express to him our appreciation of his careful work as Treasurer of the Society during the past four years, and thank him for his untiring efforts in its behalf;

Resolved, That the Secretary be instructed to send Mr. Kennedy a copy of the above resolution.

THE PRESIDENT: I have much pleasure in putting this resolution before you. We all remember Mr. Kennedy very pleasantly at our Conventions.

THE PRESIDENT put the motion, and, on a vote having been taken, declared it carried.

MR. VAN DUYNE moved, seconded by Mr. Tillson, the following resolution.

Resolved, That the thanks of the Members of this Convention are due, and are hereby extended to the President and other officers of the Society for the faithful manner in which they have performed the duties of their respective offices during the year.

MR. VAN DUYNE put the motion, and, on a vote having been taken, declared it carried unanimously, and tendered the thanks of the meeting to the President and officers.

MR. BENZENBERG moved, seconded by Mr. McMath, the following resolution:

Resolved, That we, the Members of the American Society of Municipal Improvements in Sixth Annual Convention assembled, gratefully acknowledging the hearty welcome extended by His worship, the Honorable Mayor of Toronto, and which has been so thoroughly manifested by each member of the Committee of Arrangements and also by the good people of Toronto, herewith express our sincere and heartfelt thanks to each of them and to the Toronto Street Railway Company, for the many attentions and courtesies which have been received by our ladies and ourselves during our visit here, and be it further

Resolved, That we likewise herewith express our appreciation to the Toronto daily press, for the attention they have given the proceedings of our various meetings.

THE PRESIDENT put the motion, and, on a vote having been taken, declared it carried.

THE PRESIDENT: Permit me to express my appreciation of the earnest efforts of the other officers of the Society, with whom I have been associated, to make the work of this year as successful as possible and to provide for this Convention a pabulum which perhaps may be considered somewhat heavy, and a program which may sometimes have been thoughi too long.

I especially feel like acknowledging the untiring energy of our past President, Mr. Herrmann, who has always seemed willing and anxious to assume any burden which might be placed upon him. His interest is unflagging, and the amount of work that he did in connection with the publication of the report was far more than one had a right to expect from a past President. The report was printed in Milwaukee. As a result there developed upon Mr. Benzenberg an amount of work which he might have had reason to consider too much; but he did it without hesitation.

I want also to impress upon the members here present the necessity for holding all the advertisers we had last year, and also of securing such new advertisements as are possible. Upon our success in doing this will depend out ability to pay for the publishing, in proper form, of the report of this Convention; and I hope that every member of the Society who did anything towards securing an advertisement last year will keep hold of his friends until he gets another order for the same advertisement, besides casting about for new ones. Last night, in the pressure of business and the late meeting, we did not have an opportunity to hear from the newly elected officers. The Convention certainly cannot be brought to a close without having a few words from the President and other officers newly elected; and I therefore call upon Mr. Thompson.

MR. THOMPSON: Mr. President and Members of the Society, I was very thankful for the neglect last evening when I was not called upon for a speech. No words which I may say at this time can adequately express my appreciation of the high honor which you have conferred upon me. But I fully realize with that honor there is a very heavy responsibility for the American Society of Municipal Improvements has in five short years assumed the lead among associations which devote their attention to municipal affairs. It is necessary that the position which the Society has assumed should be maintained. The very best talent in the United States and Canada has been put forth in maintaining it in the past; and officers who assume control at this time have before them a task which will require for its accomplishment the application of the talent and energy of the entire organization. I will certainly do all within my power to further the interests of the Society; but I realize the weakness of any one officer, or set of officers, and their inability to accomplish what is necessary, without the hearty co-operation of all members.

The Society in the past is to be congratulated upon the very general co-operation of its members, and I only hope that this co-operation will continue. I bespeak, therefore, for the officers-elect a continuation of this assistance, and request the members to willingly perform the duties which may be assigned to them.

Gentlemen, I thank you for the honor you have done me and the confidence you repose in me in choosing me as your President.

THE PRESIDENT: Mr. McMath of St. Louis has been elected First Vice-President of the Society, and I am sure the gentlemen present will be glad to have a few words of encouragement and counsel from Mr. McMath.

MR. McMATH: Mr. President and Gentlemen of the Society, I fully appreciate the honor, and I hope I may also appreciate the responsibility that rests upon the officers whom you have elected. In the progress of our meeting here the importance which the conduct of municipal business is getting to have in this country has been intimated. An association of this character is one which may be made to fill a very important place. There are possibilities of usefulness in this organization which we as yet do not fully appreciate; and I hope that during the coming year we may see a considerable advance is made in securing the active participation of a greater number of cities in the affairs of this Society. An effort should be made to enlist the interest and co-operation of the cities of the United States and Canada. There are opportunities presented in the meetings of this association, and in the reading of its reports, which are of very decided value, and those who stay out of the Society are the losers; but we who are on the inside must do a little missionary work and bring them to a realization of what they miss by staying outside. And when we get them on the inside we must endeavor to see to it that they take a part in our proceedings and our discussions. Now, we have been compelled in this meeting to pass by some very interesting topics with very little discussion; and yet, after all, the discussion is what brings out the value. Now, perhaps it may be wise for us, when we get on a little better fighting footing, if we are able, to extend the field of discussion and invite outside the proceedings of the Convention the written discussions of people. I think that is one way in which we can extend our usefulness; because we all learn not so much by what we have done, but what we gain from our fellows, and we can learn a great deal from comparing our mistakes.

I expected to hear this afternoon an interesting and useful discussion on the subject of the disposal of garbage, but it was passed over with very little attention. I suppose there are very few men present who could not have added something to our stock of information, either as to the way to do it or to avoid how not to do it.

Well, gentlemen, we are to separate shortly, and I hope that we may all meet under the protecting wing and auspices of friend Benzenberg next season. The Society is pretty well acquainted with Mr. Benzenberg and the other gentlemen of Milwaukee, and I am sure we will have a royal good time if we go there.

THE PRESIDENT: After a series of Conventions Mr. Saunders seems to have established a reputation for modesty, and he appears to seek to perpetuate it by having left the room just before the time when he knew he would be called on, and I am afraid Dr. Woodward has done the same thing.

We have already at five Conventions had occasion to call upon our Secretary to respond to his re-election; and I take pleasure now in calling upon him for the sixth time.

Mr. Fulton: Mr. President and Gentlemen of the Convention, I have to thank you again that you have seen fit to give me the honor of continuing me in office to which I was elected some years ago. I do not know why in particular you have continued me in office, for I often feel myself that the efforts I have put forth to interest the different cities in these Conventions have been very weak, and I often think that I ought to do more than I have done; but I do want to say that in past years, and especially in this last year, I have put forth my best efforts to secure good attendance at the Conventions, and this year I felt very badly when I received so very few responses from even the old members of the Society.

As things go in this world—sometimes everything seems to go the wrong way for a few years, and then everything turns round and all is sunshine; and for the last few years matters in financial circles have not been as bright as they have been in the immediate past, but I trust that this may be but a forecast of our experience in the coming year.

As you all know, I am always out of my element when I am trying to make a speech; and I hope you will excuse me for my poor effort on this occasion, at the same time accepting my sincere thanks for the sixth visitation of the honor of being elected Secretary of the American Society of Municipal Improvements.

The President: This association stands for a good many things in the way of better city government, and among others, although nothing has been said about it, by its precept and example it certainly should encourage civil service reform. I know of no better practical illustration of this than after a man has served successfully for several years as Chairman of the Finance Committee to impose upon him the weighty responsibility of the custody of our funds. We shall be very glad, indeed, to hear from Mr. O'Brien, our new Treasurer.

Mr. O'Brien: Mr. President and Gentlemen of the Convention, I do not suppose there was any more surprised man in the room last evening than I when the Committee came in and recommended, among other nominations, that I should be Treasurer.

I certainly did not feel as though I deserved it; I thought there were older men—men representing larger cities, men better fitted, and men whose election to office would be more of an advertisement to the Society than putting me there could possibly be. But you did it, and I thank you sincerely; and I will try and administer the duties, if not as well as my predecessor, as well as I can.

THE PRESIDENT: Mr. O'Brien may find the duties of his office too burdensome, and it may be necessary to find a successor; if so, we have a man in training, and we should be very glad to hear what he can promise. Mr. Howe, Chairman of the Finance Committee, will you kindly say something to the Convention?

MR. HOWE: Mr. President and Gentlemen, with the financial assistance of the members of the Society, and the united efforts of your Finance Committee, we hope to present to you a satisfactory report next year. I thank you for the honor conferred upon me.

THE PRESIDENT: We have not yet heard from Mr. Joseph Emmer of Grand Rapids.

MR. EMMER: Mr. President and Gentlemen of the Convention, I thank you heartily for the honor you have conferred upon me last evening; but I want to say, that while I shall attempt to do my duty in the future, I am but a new member. I expect to be with the Society for the next few years, and I will do my best while with you.

THE PRESIDENT: Mr. Cook, I believe, is not present, and therefore we cannot call upon him.

I have an announcement which I wish to make. I am sorry it was not made a little earlier, before some of our members left the hall. All through the Dominion our Canadian friends have a good deal of pride in their military organizations. I am not sure whether I am safe in saying that the regiment of which I am about to speak is the "7th Regiment" of Toronto or not, but I know it is one of their crack regiments.

I have a memorandum which says that the Royal Grenadiers will parade at their Armouries at 8 o'clock, and admission of the delegates, in a body, may be had at the south door on Osgoode Street at 7:50, when they will be escorted to the Officers' Gallery. The regiment will then march out, and ladies and others may see it march past the city hall. I think you will find this an interesting spectacle, and I hope all members of the Society who are in the city this evening will take advantage of this opportunity to see the drill of one of the crack regiments of Canada.

I might call the attention of the Society to quite a lengthy petition which has been placed on the table this afternoon. It is addressed to the Premier of the Dominion House of Commons, and is a petition for British-like produce markets and public fairs for selling cattle, sheep, hogs and other live stock, etc.; and if any of you are interested you may read the petition and look into the question. I do not know how it came here.

MR. AMES: I did not get an office, but I want to say a word. It occurred to me, as Mr. McMath was speaking about lack of discussion on garbage disposition, that many of the men who have that work to do in their cities are not here. In the city of Grand Rapids the Board of Health has charge of the disposal of the garbage, and the Street Commissioner cleans the streets. It seems to me, if this Society does not include the Boards of Health, we might fix it so that it would.

Then, there is also another thing that has not been touched upon, and that is the care of parks and cemeteries. That has never found a place in these papers. Although every place we go we are shown parks, nothing appears in our proceedings in regard to the care of parks or the beautification of our streets, except that last year I think there was a paper on "Tree Planting in the Streets of Washington." This is a feature that I think the Society might give some attention to.

MR. JONES: I had very much pleasure to-day in nominating as a member of this association our Park Commissioner of Toronto. I think with Mr. Ames that the cities in the United States are largely interested in parks and park systems, and it would be well for this Society to have upon its Rules of Order a place where papers upon park systems and park maintenance could properly be discussed. I am quite satisfied that if our Park Commissioner, who now by a vote of this Society is a member, is alive and well next year, that he will be only too glad to prepare and read a paper explaining his method of care and the cost and so on of Toronto's parks.

In reference to garbage disposal, it is a matter that has not, to my mind, received that attention from the meetings of this Convention that it should have received. It is a question, too, that is taking up the attention of a great many of our municipalities, in the larger cities especially. Perhaps the difference that has just been mentioned—that in several cities or in large cities of the United States it is under the control of the medical health officer—may be one of the reasons that it has not been so thoroughly discussed at our meetings, as I think it should have been.

Our system in Toronto, as I said in a paper to-day, is controlled all by one head. The system includes the disposition of the garbage, street cleaning and street watering.

I have been a little disappointed. I might say to you that there has not been, either at this Convention or at the former ones, that discussion upon the proper method of the collection and disposal of garbage that I think there should have been; for I think, as I said at Washington last year, the health of the city, in my opinion, is one of the most important questions that we can bring up and discuss and I know of nothing that is so conducive to the health of the city as its proper cleanliness. I think the members of the association will all agree with me upon that point, and I would certainly like to see the question taken up and dealt with more thoroughly than it has been done in the past.

MR. BALL: Mr. President, the city of Washington has two large areas, which in the next few years will be likely devoted to park development; one of about 700 acres lying along the Potomac River, and the other, about 2,000 acres, lying along Rock Creek. I am sure I represent the engineer, Captain Beach, when I say that he is interested in that question as much as in any question relating to the municipal administration of which he is in charge.

The smaller park system of the city, as you are aware, is not controlled by district authorities, but is under the care and management of the officers of public buildings and grounds.

It does seem to me that this Convention could well provide for taking up the question of park development and administration at one of its future meetings. I am very sure it would be practicable to get the experience of the engineer in charge of that department at Washington, and that we would be very much interested in that discussion

If you run over in your minds the authorities on such questions you will find they are very, very few in number. It is a subject which is well worthy of the investigation of this Society, and I may say it is a subject of which too little is known.

MR. AMES: I would like to see a standing committee appointed; and I move that a standing committee be appointed on park development. I am not particular about the title of the committee so long as it covers the ground that has just been suggested.

MR. JONES: If it is in order and in accordance with the Constitution, I would second the motion.

THE PRESIDENT: I think it is in order. It might be a special committee this year, and be made a standing committee next year.

MR. JONES: I will second it then as a special committee.

MR. AMES: And I will consent to that.

THE PRESIDENT: It is moved and seconded that a special committee be appointed this year, to be known as the Committee on Park Development and Maintenance. Carried.

MR. LEWIS, the retiring President, then called on Mr. Thompson, the President-elect, to take the chair.

PRESIDENT THOMPSON: I wish to announce that several of the chairmen of the different committees have been selected.

On motion of MR. MCMATH, seconded by Mr. Jones, the Convention adjourned to meet in Milwaukee on the call of the Secretary.

INDEX.

BUSINESS PROCEEDINGS.

ADDRESS: PAGE.
- Of Welcome, Mr. John Shaw, Mayor of Toronto 19- 20
- Of Thanks, Mr. N. P. Lewis, President 21
- Annual, President N. P. Lewis 23- 27
- By Newly Elected Officers 287-291

BY-LAWS:
- Proposed by Executive Committee 224, 225
- Adoption 226

COMMITTEES:
- Standing 4
  - Discharged 285
- Nominating, Appointment of 83
  - Report of 227
- Special, on Municipal Statistics 77, 223
- On Next Place of Meeting, Appointment of 84
  - Report of 228
  - Adoption of Report 229
- Local, Announcements of 37, 122, 230, 291

CONSTITUTION:
- Constitution 9- 13
- By-Laws 14

ELECTION:
- Of Members 28, 83, 244
- Of Officers 227

MEMBERSHIP:
- List of Cities 15
- List of Members 16- 18
- Election to 22, 83, 244

OFFICERS:
- Officers 3
- Election of 227

REPORTS: PAGE.
Of Secretary 27- 29
Of Treasurer.......... 30- 34
Of Executive Committee.......... 224, 225
Of Finance Committee.......... 223

RESOLUTIONS:
To Dispense with Reading of Minutes.......... 22
To Appoint Special Committees on Municipal Statistics.......... 77
Of Thanks to Allen Hazen 219
Directing the Executive Committee to Report on Amendments to the Constitution.......... 226
Recommending Time of Next Meeting.......... 230
Of Thanks to former Treasurer J. L. Kennedy.......... 285
Of Thanks to Retiring Officers.......... 286
Of Thanks to His Honor, the Mayor, and Others.......... 286
To Appoint a Committee on Park Development and Maintenance.. 294

PAPERS.

"Is a House Sewer-Trap Always Necessary"—By Chas. B. Ball, Plumbing Inspector, Washington, D. C.......... 50- 53
Discussion of same.......... 53-66, 284

"Water Rates and Statistics Pertaining Thereto in the Larger Cities of the United States"—By Aug. Herrmann, Commissioner of Water Works, Cincinnati, O.... 85-102
Discussion of same.......... 102-110

"Electrolysis: From the Standpoint of the Municipal Electrician"—By H. S. Wynkoop, Electrician, Dep't of Public Buildings, Lighting and Supplies, Brooklyn, N. Y.... 111-115
Discussion of same.......... 115-122

"Life of Pavements"—By G. W. Tillson, Principal Assistant Engineer Dep't of Highways, Brooklyn, N. Y.......... 133-148
Discussion of same.......... 169-188

"Physical Properties of Asphalts and Asphaltic Cements"—By W. H. Broadhurst, Chemist, Dep't of Highways, Brooklyn, N. Y.......... 148-152
Discussion of same.......... 182-188

"Damages for Non-Repair of Highways"—By Hon. J. S. Fullerton, Queen's Counsel, Toronto, Can.......... 152-159

PAPERS—Continued. PAGE.

"Creosoted Wood Block Pavements in Indianapolis"—By M. A. Downing, Prest. Board of Public Works, Indianapolis, Ind. 160–163

"Brick Paving in Various Cities as Viewed by an Observer in Search of Information"—By L. M. Hastings, City Engineer, Cambridge, Mass 163–169
Discussion of same 169–188

"Rail Bonds vs. Water Pipes"—By Harold P. Brown, Electrical Engineer, New York 189–193

"Taxation and Assessments"—By G. T. Bouton, Sec'y Street and Water Commission, Jersey City, N. J. 194–196
Discussion of same 197–199

"Some Experiences with Portland Cements"—By W. K. Eldridge, City Engineer, Lafayette, Ind. 199–206
Discussion of same 207

"Pavements Between Railway Tracks"—By C. H. Rust, City Engineer, Toronto, Can. 208–212
Discussion of same 212–215

"Views of Water Works Filtration Plants"—By Allen Hazen, Consulting Engineer, New York 218

"Disposition of Garbage at Cincinnati, O."—By Aug. Herrmann, Pres't Board of Trustees, Commissioners of Water Works, Cincinnati, Ohio 241–244

"Outline of the System of Garbage Collection and Disposition in the City of Toronto"—By John Jones, Street Commissioner, Toronto, Can. 245–248

"Garbage Crematories"—By E. Coatsworth, City Commissioner, Toronto, Can. 248–250
Discussion of same 250

"Collection and Disposition of Garbage and Street Sweepings in Wilmington, Del."—By H. J. Wiley, Secretary Street and Sewer Dep't. Wilmington, Del. 251, 252

REPORTS.

PAGE.
Of Committee on Electric Street Lighting........................ 38– 48
  Discussion of same.. 48, 49
Of Committee on Municipal Data.. 67– 70
  Discussion of same.. 70– 82
Of Committee on Taxation and Assessment.. 85–194
Of Committee on Street Paving..124–132
  Discussion of same..169–188
Of Committee on Water Works and Water Supply..216, 217
  Discussion of same..220–222
Of Committee on Disposition of Garbage and Street Cleaning..232–241
  Discussion of same..252–256
Of Committee on City Government and Legislation.. 256
Of Committee on Municipal Franchises..259–267
Of Committee on Review..268–284

THE Executive Committee desires to call the special attention of the members of the Society to the advertisers. Let us help those who help us, and thus cause this book to be recognized as the valuable advertising medium it is.

This magazine is the foremost in the world devot municipal work. It has been said of it that "its volu constitute the really valuable literature on the subjec municipal engineering."

It received the World's Award for excellence.

PAVING
SEWERAGE
MUNICIPAL
ENGINEERING
WATERWORKS
PARKS
A MONTHLY MAGAZINE
DEVOTED TO THE IMPROVEMENT OF CITIES
GOOD ROADS. STREET CONSTRUCTION, CLEANING AND LIGHTING, SANITATION, BRIDGES.
PUBLISHED BY
MUNICIPAL ENGINEERING COMPANY
INDIANAPOLIS NEW YORK

From Detroit Journal.—Municipal Engi has been a large factor in an educational way i remarkable progress in the improvement of ci

From Philadelphia Press.—Municipal Eng ing is itself a good example in enterprising an gressive work.

From Kansas City Times.—Municipal Eng ing is the most helpful publication in America who are interested in public improvements.

From Boston Herald.—Municipal Engine full of valuable technical and professional infor

From Sacramento (Cal.) Record-Union.— municipal officer in the land ought to have an Municipal Engineering.

From the Tacoma (Wash.) Daily Ledger— standard of Municipal Engineering is high.

Every number contains special articles by leading authorities. It gives all curre formation on new methods and ideas. It answers questions from subscribers on tech matters. It contains the latest contracting news from the entire country.

A monthly magazine of 128 pages, illustrated.
Subscription—$2.00 a year; single copies, 25 cents; they are worth too much to be sent gratuitously. Address,

Municipal Engineering Co., 84-85-86 Commercial Club Bldg., Indianapolis.
275-A Washington Bldg., New York.

THE ENGINEERING RECORD

GIVES PROMINENCE TO

MUNICIPAL ENGINEERING.

Construction and Operation of Water-Works, Sewers and Sewage Disposal Plants, Roads and Pavements, Garbage Disposal.

GENERAL CIVIL ENGINEERING.

Docks, River and Harbor Improvements, Subways, Canals, Contractor's Plant.

STRUCTURAL ENGINEERING.

Bridges and Buildings, Ventilation, Heating, Elevator Service, Lighting, Plumbing.

STEAM ENGINEERING.

Design, Construction and Management of Power Plants.

Published EVERY SATURDAY, at 100 WILLIAM STREET, NEW YORK.
$5.00 per year; Single Copies, 12 Cents.

THE ENGINEERING RECORD is the recognized medium for advertisements inviting proposals for all Municipal and U. S. Government Engineering and Public Building Work. Its subscribers include the experienced and reliable Contractors and Manufacturers of Engineering and Building Supplies in all sections of the United States and Canada. The RECORD'S value to secure competition in bids is therefore obvious.

All important facts relating to Street Improvement, Garbage Disposal, Water and Sewage Purification, in short, the very things in which so many City Engineers and Officials are most interested, are fully recorded and carefully described in

Engineering News.

Our supplement of construction news and contract prices is also of great value to municipal officials.

Some of our books are:

Road Making and Maintenance; Herschel and North,	$ .50
City Roads and Pavements; Judson, - - -	1.00
Hydraulic Diagrams; Swan and Horton, - -	1.00
Elements of Water Supply Engineering; Gould, -	2.00
Cleaning and Sewerage of Cities; Baumeister, -	2.00
Manual of American Water Works; Baker, - -	3.00

A full price list of books and a sample copy of Engineering News will be sent free on request.

THE ENGINEERING NEWS PUBLISHING COMPANY,
220 Broadway, New York.
CHICAGO. CLEVELAND. BOSTON. LONDON, (England).

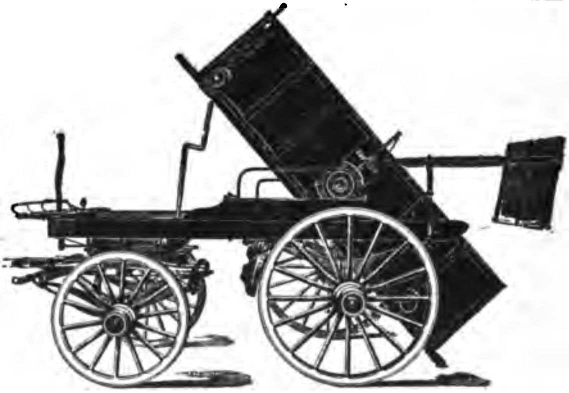
For Every Purpose

THE

ECLIPSE

Dumping Wagons

Have No Equal.



DESIGNED SPECIALLY FOR HAULING

ASPHALT, BRICK, ETC.

Sewer Droppings, Garbage, Sand, Gravel, Crushed Stone, Etc.

WE ALSO MANUFACTURE A FULL LINE OF HIGH GRADE

BUSINESS WAGONS, PATROL AND SALVAGE WAGONS,
HOSE CARRIAGES AND WAGONS, STREET SWEEPER, CARTS, etc.

WM. BECKERT,

Send for Catalogue. **1001-1005 Ohio St., Allegheny, Pa.**

The Western Paving
and Supply Co.

CONTRACTORS FOR

**Trinidad Pitch Lake
Asphalt Pavements.**

**The Ideal Pavement of Modern Times.
The Standard Pavement of America.
The Coming Pavement of the World.**

**Over ten million sq. yds. in use in the United States.
It is smooth, durable, easy and cheaply
cleaned, cheaply and perfectly
repaired.**

For Estimates and Particulars Address:

General Offices, CHICAGO, ILL., INDIANAPOLIS
and MILWAUKEE.

Alcatraz Asphalt

GUARANTEED FREE FROM COAL-TAR
OR PETROLEUM RESIDUUM,

FOR

STREET PAVEMENTS.

TRADE MARK
ALCATRAZ
AA
ASPHALT.
REGISTERED

RESERVOIR LININGS,

Pipe Dip, Paints, Etc.

The Alcatraz Company,

Crocker Building,

San Francisco, Cal.

New York Offices:
3 West 29th Street:

Asphalt Pavements

LAID
WITH

TRINIDAD LAKE
ASPHALT

Are the STANDARD PAVEMENTS
OF AMERICA.

* * *

For Plans and Specifications, apply to

THE BARBER ASPHALT
PAVING CO.,

No. 11 Broadway, NEW YORK.

* * *

GEN. F. V. GREENE, President
P. W. HENRY, General Manager.

The Sicilian Asphalt Paving Company,

TIMES BUILDING NEW YORK.

Sicilian Rock Asphalt Floors, Pavements and Roofs

for Hospitals, Cellars, Kitchens, Breweries, Warehouses, Manufacturers Railroad Platforms, Sidewalks, Slaughter Houses, Stables, etc.

* * *

Sicilian Rock Asphalt Pavements
for Streets.

* * *

Trinidad Asphalt Pavements
for Streets.

* * *

Gruenzweig & Hartmann's Patent Cork Insulation

for Walls, Partitions, Floors and Ceilings of Breweries, Ice Houses, Refrigerating Plants and Cars; also for
ing of Boilers, Steam and Brine Pipes.

New York and
Bermudez Co.

Importers, Refiners
and Dealers in

Bermudez Lake Asphalt,

STREET PAVING,
ROOFING COMPOUND,
RESERVOIR LINING,
MASTIC and
CEMENT.

GENERAL OFFICES:

BOWLING GREEN BUILDING
NEW YORK.

Room 1663. **Telephone, 1854 Broad.**

REFINERY AND WORKS:

SOUTH AMBOY, N. J.

Mack Manufacturing Co.

VITRIFIED.....

Paving

Bricks

and

Blocks

Of High Grade for Cities and Towns.

GENERAL OFFICES,
WESTINGHOUSE BLDG.

Pittsburg, Pa.

WORKS:

ROCKY SIDE, UNION, EAGLE, ÆTNA, CLIFTON,
CRESCENT, SLIGO, located at New
Cumberland, W. Va.

We invite correspondence from those desiring Vitrified Paving Material of acknowledged superiority in respect to durability, uniformity and beauty.

THE EASTERN
PAVING BRICK
COMPANY

Manufacturers of

Vitrified Paving Brick,
Paving Blocks,
Sewer Brick, etc.

WORKS AT CATSKILL, N. Y.
AVERAGE DAILY CAPACITY, 125,000

NEW YORK OFFICE,
EMPIRE BUILDING, 71 BROADWAY.

“Milwaukee
Hydraulic
Cement”

Correspondence
Solicited.

For uniformity of grind and ultimate strength it stands unrivalled . . . .

MILWAUKEE
CEMENT CO.

Capacity, 4,000 Bbls. per day
Annual Sales, 500,000 Bbls.

MILWAUKEE, WIS.

Thomson Meter Co.

WATER METER MANUFACTURERS,

78-83 Washington St., BROOKLYN, N. Y.

Our Meter, the ***"Lambert."***

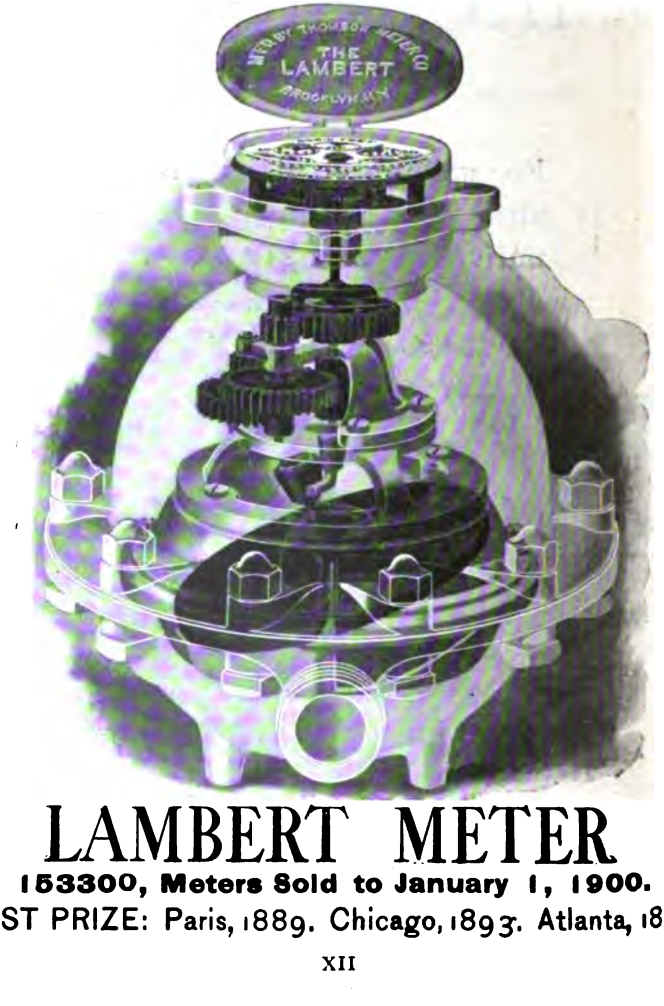
OUR PROGRESS:

METER No. 50,000 STAMPED AND SHIPPED TO COUNCIL BLUFFS, IOWA, MARCH 31, 1894.

METER No. 100,000 STAMPED AND SHIPPED TO PROVIDENCE, RHODE ISLAND, AUGUST 24, 1897.

METER No. 150,000 STAMPED AND SHIPPED TO WOONSOCKET, R. I., DECEMBER 28, 1899.

Jubilee Catalogue and Price List Furnished on Application.


MFD. BY THOMSON METER CO.
THE LAMBERT
BROOKLYN, N.Y.

WE NUMBER OUR METERS ONLY AS WE SELL THEM.

LAMBERT METER

153300, Meters Sold to January 1, 1900.

FIRST PRIZE: Paris, 1889. Chicago, 1893. Atlanta, 1895.

Trident

Disk Water Meter,

**With Resilient or Retroactive
Frost Bottom.**

"SECOND TO NONE" in form, material, construction, capacity, initial accuracy and sensibility.

SUPERIOR TO ALL in convenience, in solidity of parts, in design, in maintained accuracy and in immunity from stoppages.

MAY BE RUN HARD AND LONG without smashing, and be frozen partially or entirely solid without damage to the meter or expense to the owner.

FULLY ATTESTED, by most competent authorities, as being "beyond competition in low cost of maintenance."

Illustrated Catalogue, giving full details, mailed to any applicant.

Neptune Meter Company,

253 BROADWAY,

Designed by JOHN THOMSON.

NEW YORK CITY.

MEACHAM & WRIGHT

Manufacturers' Agents for

Utica Hydraulic Cement

And Dealers in

IMPORTED and AMERICAN PORTLAND CEMENT,
MICHIGAN and NEW YORK STUCCO,

Telephone, Express 59.

308-309 CHAMBER OF
COMMERCE BLDG.,
Chicago, Ill.

LEAD LINED IRON PIPE IS THE BEST PIPE FOR SERVICES. IT WILL NOT RUST OUT. HALF THE COST OF LEAD PIPE....

❧ ❧

Lead Lined Iron Pipe Co.

WAKEFIELD, MASS.

C. B. JOHNSON, President.
J. J. WILSON, Vice President.
E. H. BAILLIE, Secretary.
CHAS. H. BERGEN, Chief Engineer.
W. D. SHERMAN Mechanical Engineer.
H. A. MINER, Solicitor.
F. B. JOHNSON, Treasurer.

The Wilson & Baillie Manufacturing Co.

Main Office and Factory, 85-93 Ninth Street, Brooklyn, N. Y.

MANUFACTURERS OF

TRADE
KOSMOCRETE
MARK

Patent Machine Made "Portland Cement"

SEWER PIPE,

EGG SHAPE WITH FLAT BASE.

Can be laid to a Perfect Gradient.

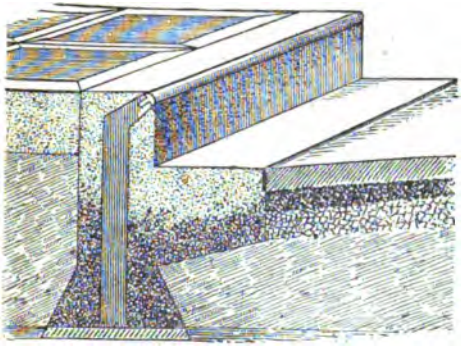
Pronounced by Engineers who have seen the method of manufacture to have no equal.

KOSMOCRETE ARTIFICIAL STONE

For Sidewalks, Driveways, Copings, Steps, Railroad Depot Platforms, Flooring for Warehouses, Appartment Houses, Water-tight Cellar Floors and Improved Stable Floors.

Kosmocrete Steel-Bound Curb

"Wainwright's Patents."



The Steel-Bound Curb is superior to any natural stone.

Laid in twenty-foot lengths, with invisible joints, with concrete foundations, is never out of line.

Galvanized steel edges cannot rust or break.

It is the most beautiful and durable curb laid, and with gutter combined, is the ideal for asphalt or macadam streets.

HEAVY CONCRETE CONSTRUCTION

A Special Feature of Our Business.

By permission we refer to the Engineers and Architects in Charge of the following work:

Bowling Green Bldg., Kosmocrete walks laid on Broadway and Greenwich Street fronts.
Six miles of foundations for Union Elevated Railroad of Brooklyn.
Swimming Tank, Bergen Beach, Brooklyn.
Sea Wall, Wallabout Market, Brooklyn.
Causeway, New York Navy Yd., Brooklyn.
Sidewalks, Curbs, etc., Terminals, New York and Brooklyn Bridge.
Sidewalk, 5 miles long, 8 feet wide, Ocean Parkway, Brooklyn.
Sidewalks, Curbs, etc., N.Y. State Armories, 23d Regiment, Brooklyn, 14th Regiment, Brooklyn; Cahoes, Utica, Hornellsville.
Capitol, Albany, N. Y., Floor of Terrace, 10,000 sq. ft.
Sidewalk and Curb, Rensselaer Co. Court House, Troy, N. Y.
Fireproof Floors, Abraham & Straus' New Warehouse, Brooklyn
Watertight Cellars, Williams Building, 184 South St., N. Y., and many others.

This Company, in conjunction with Mr. T. Henry Dumary, are the successful bidders for constructing the Water FILTERATION Plant, Albany, N. Y. Contract Price, $309,866.47

Engineers and Contractors are invited to inspect The Sherman Aerial Hoisting, Carrying and Distributing Apparatus which is employed in this work.